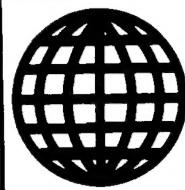
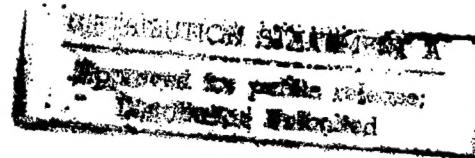


21 July 1993



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# ***JPRS Report***



# **Science & Technology**

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# Science & Technology

## Europe/International

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## ADVANCED MATERIALS

### Composite Materials, Bioactive Fibers

93WS0522A Berlin INGENIEUR DIGEST in German  
No 6, Jun 93 pp 40-41

[Article by Klaus Ziegert]

[Text]

### Metals Reinforced

The production of high-performance materials made of textile-reinforced metals will soon be possible, though in limited quantities. This was announced by the Chemnitz University in its booth at the approach to the International Trade Fair of Engineering Textiles and Textile-Reinforced Materials. Extensive tests have shown that textiles, whether in fiber or sheet form, are suitable for this application. Basically, the mechanical properties of the composite material are determined by the textile reinforcement and its thermal properties are determined by the metal matrix. Products made of textile-metal composite materials can, therefore, carry heavier mechanical loads while remaining thermally more stable.

One of the most remarkable development comes from the U.S.: the novelty is thin-film metallization. The process facilitates deposition of the thinnest layers by chemical treatment. Metals can thus be deposited in single or several layers on fibers, yarns, or textile sheets. The metallization is an excellent electrical conductor and at the same time oxidation-resistant. Such products are suitable for many applications in electronics such as for shields keeping out electromagnetic radiation.

The new composite material consisting of impregnated aramide fleece and copper foil, recently introduced by the German Freudenberg consortium, offers amazing technical solutions to problems of printed-circuit manufacture. It is particularly suitable for flat cable and for single-layer or multilayer circuit boards. Owing to its high degree of flexibility, this material producible in foils is also very good for movable modules. It can withstand operating temperatures up to 120°C. Additional advantageous features are problem-free processing and excellent machine solderability. Since there are no glass fibers in this material, it can be drilled and contoured with a laser beam. Future applications will be in printer circuits, automotive electronics, and cameras.

At the same time independent work is being done on thin-film laminates for insulations and on a new carrier material for heater foils. A specialty paper has been developed and added to polyimide fibers, the resulting insulation material being heat-resistant up to 260° and highly flame-resistant.

The diversity of innovations made possible by use of engineering textiles is further demonstrated at the Frankfurt Trade Fair on transpiratory anticorrosion membranes. When combined with sheet products, they prevent condensation of water vapor during temperature variations. Excess heat, for instance, can thus be removed during uncovering of electric motors.

Producers as well as users are showing such a great interest in textile-reinforced composite materials that the trade organizers have in 1993 for the first time made available to their representatives a separate discussion forum on this subject with "Compositex" denoting the central theme.

Not only high-tech fibers are subject to an upward trend. So also are more ordinary engineering textiles. In the opinion of the chemical fibers industry, strong pushes in this direction come from innovative proposals regarding auto safety and above all the air bag. Air bags will be made primarily of polyamide yarn. The total worldwide market for restraint systems is expected to expand from \$3.5 billion in 1990 to over \$10 billion by 1995-96.

"The market for engineering textiles and textile-reinforced materials is continually expanding," says Dr. Wolfgang Kater, business manager of the Frankfurt Trade Fair. "The engineering sector accounts already for 25 percent of the demand for chemical fibers in West Europe." Inasmuch as also a rising demand for textiles by the construction industry is anticipated, a major exhibit is devoted to earthwork, waterwork, and roadway construction covering underground and overhead engineering structures including the interior outfit.

For knurling one may use the French process applied to synthetic textiles and plastic scrap for floor stabilization. Embedding is to be effected either by layerwise pouring or in the form of pressed bales. The pouring method could yield a higher load capacity in construction of a mountain road. With a steeper slope angle, 55° instead of 33°, it has been possible in this way to save appreciable quantities of bulk material.

The effectiveness of the baling method was demonstrated in construction of an experimental dam. The new process opens up cost saving possibilities, especially because large quantities of tailings can be expediently utilized not only in street, railway roadbed, and escarpment construction primarily but also in protective walls erected along falling rock zones or as noise barriers.

This year the Frankfurt Fair is also committed to the greater promise of high-tech textiles for hospitals. An example is antimicrobial fibers, a market which is being invaded by American and Japanese manufacturers as well as by European ones. In this case antimicrobial substances are directly grafted into the fibers so that the material retains its germicidal quality after washing or chemical cleaning. Hospital garments, bedclothes, and towels are among the most favored applications for these fibers.

**Bioactive Fibers**

Significant progress is evident in the area of bioactive fibers. An important role, along with bactericidal textiles for covering wounds, will be played here by self-dissolving substances used in surgery. Development of antithrombotic fibers with chemically injected agents is imminent. Finally, there has been developed an anesthetic bandage material which relieves pain for quite long periods of time.

The 1993 Fair is not the last additional opportunity to become informed about current trends in this field: The concurrently held Fifth International Symposium on high-tech textiles will provide a worldwide overview of all innovative developments in this technology and all markets for it.

**AEROSPACE****Germany: Rotex Space Robot Operates on D-2 Mission; Major Trial**

MI0906135693 Munich SUEDDEUTSCHE ZEITUNG  
in German 3 May 93 p 12

[Article by Erich C. Setzwein: "Robot Arm Catches Dice—Rotex Space Experiment a Success"]

[Text] Although the pictures from onboard Spacelab are becoming increasingly hazy, the mood in the German space control center at Oberpfaffenhofen near Munich is becoming happier and happier. While this has firstly to do with consistent power saving, which will enable the American space shuttle to stay in space for an extra day, the scientists are mainly celebrating the successful experiment with the Rotex robot. On Saturday night, a machine controlled from the earth was able for the first time in the history of space travel to catch a free-floating object, a task that astronauts themselves sometimes find difficult.

The Oberpfaffenhofen robotics experts were unable to predict how the mechanical gripping arm would behave under microgravity. Although it appeared last Friday, when the experiment started, that Rotex was not going to cooperate, it reacted very sensitively in assembling plug-in connections. This had already been tried on the ground, but there was uncertainty about the task that was probably the most difficult, that of catching a dice floating freely in the microgravity environment.

Tension in the control room rose as Klaus Landzetti of the German Aerospace Research Establishment (DLR) Institute of Robotics and Systems Dynamics in Oberpfaffenhofen moved the gripping arm in the direction of the small aluminum dice, and positioned the grippers. It took a while for the tiny stereo camera at the tip of the robot arm to find the toy-sized dice. Using its automatic search program, Rotex "recognized" the object, automatically extended its hand, and grabbed the dice. The

operation that worked when controlled from the ground is to be repeated on Monday morning by Hans Schlegel in Spacelab.

**EC Experiments on Russian Photon Capsule Summarized**

BR0806143593 Paris MUTATIONS MICROGRAVITE  
in French 15 May 93 pp 5-6

[Unattributed article: "ESA Experimental Projects Aboard Russian Photon Capsules"]

[Text] Photon recoverable capsules will carry out microgravity experiments on board spacecraft for the European Space Agency [ESA] between 1983 and 1996.

The experiments will be conducted following an agreement between the Russian authorities and the ESA, which has a budget of 35 million French francs [Fr]. The agreement will permit the relaunch of the Biopan and Biobox experimental modules and two new experiments in fluid physics, including one on "liquid columns" for the ELGRA (European Low-Gravity Research Association).

**Biopan**

Developed by the German company Keyser Threde at a cost of Fr14 million, Biopan is a container fixed to the outside of the capsule. It opens when the capsule is in orbit to expose the experiments to cosmic rays and closes prior to the capsule's reentry into the atmosphere.

Biopan has already completed a two-week flight on board the Photon. It should be launched three times during the new program.

**Biobox**

Built by Dornier (Deutsche Aerospace) at a cost of approximately Fr20 million, Biobox is an incubator intended to study the effects of microgravity on living organisms. It contains a centrifuge to reproduce the earth's gravity in order to determine the effects of microgravity compared to general physical conditions in orbit. Biobox was launched in December 1992 on board a Photon capsule. The flight was disturbed by a rise in the temperature due to a malfunctioning in the heat control system. Once the problems are solved, Biobox should complete two new flights on Photon.

**France: Arsene Minisatellite Launched**

93WS0554C Paris AFP SCIENCES in French  
19 May 93 p 7

[Text] Paris—France's first minisatellite Arsene (Ariane Radio-Ham Satellite for Teaching about Space), launched by an Ariane rocket on 11 May, was placed into its final orbit on 17 May when its apogee boost motor was successfully fired. A National Center for Space

Studies (CNES) official, Mr. Michel Thoby, made the announcement (see AFP SCIENCES No. 873, 13 May, 1993, p 5).

Ignition, which began at 11:45 UT and lasted a quarter of an hour, boosted the satellite into its planned orbit at 37,000 km apogee and 17,500 km perigee and an angle of 1.6 degrees. Students of the National Advanced Institute for Aeronautics and Space (ENSAE, or Sup'Aero), in Toulouse, sent the commands from the station they built with the CNES.

Though everything is "nominal" in remote sensing, the satellite's transmission capabilities are nonetheless limited, Mr. Thoby confirmed. The VHF channel (145 MHz) is silent; only 435-MHz UHF band uplinks and 2.4-GHZ SHF band downlinks work. ARSENE is equipped with two repeaters. One is linear and the other transmits in "packets" in the usual VHF and UHF frequency bands and in the SHF band. The cause of the failure is still unknown.

#### Radar To Be Carried By ESA Envisat Satellite Described

BR1606140493 Paris *LA LETTRE DU GIFAS*  
in English 20 May 93 p 1

[Unattributed article: "A New Generation of Space Radars"]

[Text] A team of Matra Marconi Space engineers based at Portsmouth (UK) has developed and is now manufacturing the ASAR [Advanced Synthetic Aperture Radar], a space radar for civil applications to be carried by the European Space Agency's observation satellite Envisat. This program is a follow-up to the ERS-1 [European Remote Sensing] satellite which has been operating in orbit to complete satisfaction.

The ASAR, a new generation synthetic opening radar, will improve reliability, images and observation shot frequency. This radar integrates technological features employed for the first time in space such as an active distribution phase control network antenna. Instead of being supplied from a single transceiver (like conventional radars) ASAR receivers will be distributed over the front part of the antenna—in all, around 320 modules. The antenna beam is oriented by controlling the supply and signal phase of each module. In this way, the width of the radar beam can be extended to the horizon—at approximately 700 km from satellite ground trace. Authorities operating the radar will now have a greater choice in image targets and the possibility of covering a narrow band with high definition or a 500-km band with lower definition. The time to return over any point on the globe has been greatly improved. Coverage of equatorial zones, for example, is increased from 22 to 100 percent for a three-day repetition cycle.

Another advantage directly derived from the antenna technology is that operational duration of the radar is doubled per orbit. The ASAR will offer significantly

improved performance obtained by the dual polarization of radar signals which makes for better spectral detail and improved analysis of radar images.

#### United Kingdom: Supersonic Spacecraft Based on HOTOL Concept Planned

BR0806143393 Rijswijk *POLYTECHNISCH WEEKBLAD* in Dutch 21 May 93 p 4

[Article by Gerard van Nifterik: "Great Britain Still Wants Manned European Space Flight"]

[Text] London—Great Britain does not want to be left behind in the development of a supersonic spacecraft. Recently, THE TIMES newspaper reported that Technology Minister Leigh wants to earmark the equivalent of 10 million Dutch guilders for developing Britain's own supersonic spacecraft.

Until now, Britain has not been very adventurous with regard to spacecraft. It was involved in the "Blue Strike" project in the 1960's, but that undertaking was laid to rest. Even the spectacular HOTOL [Horizontal Takeoff and Landing] spacecraft was definitively mothballed a few years ago. On top of this, the United Kingdom has always distanced itself from European projects.

#### Mincemeat

During the ESA [European Space Agency] conference in The Hague in 1987, at which the ESA cleared the way for manned European space travel, the UK delegation made mincemeat of the European plans, refusing to take part in the Hermes, Ariane 5, or Columbus projects. Mr. Clark, who was the minister for trade and industry at the time, described the European plans as unrealistic, unnecessary, and far too ambitious. Although feelings have now cooled down to some extent, the UK has adopted a fairly isolated position regarding European space travel—particularly manned space transport systems—ever since.

#### Un-British Opportunism

This position now seems to be changing somewhat. It could even be said that there are signs in Great Britain of quite un-British opportunism. THE TIMES anticipates a fleet of 40 space planes, designed in Great Britain, which could cover the distance between London and Sydney, Australia, in one hour. These aircraft could possibly be built in an Airbus-like consortium, involving the participation of other European countries. Apparently, space travel is once again on the agenda across the Channel.

Great Britain currently has two designs on the drawing board, both partially based on the old HOTOL design. One of them is a smaller version, known as Interim HOTOL, developed by British Aerospace Space Systems. It is a rocket-type craft which can be launched from the back of a Russian An-225 freight aircraft.

**Skylon, the Updated Version of HOTOL**

The second design, known as Skylon, is a relatively new design which can be considered an updated version of HOTOL. It is fitted with two SABRE (synergetic air breathing and rocket engines) engines. If necessary, these can operate as conventional airplane engines taking oxygen from the atmosphere. However, they can also operate like rocket engines, using a mixture of liquid hydrogen and oxygen. The launch cost of the system is expected to be no more than 1 percent of that of the current generation of American Space Shuttles.

Great Britain wants to submit its Interim HOTOL and Skylon plans to ESA's FESTIP [Future European Space and Transportation Program] program. In the long term, FESTIP will determine which system or combination of systems is suitable for further development in Europe. HOTOL and Skylon will have to compete in this field with German and French designs.

**Ribbed Foil Coating To Lower A-340 Fuel Consumption**

*BR0706140893 Rijswijk POLYTECHNISCH WEEKBLAD in Dutch 24 May 93 p 1*

[Unattributed article: "Airbus Now Also To Cover A-340 With Rugged Film"]

[Text] Toulouse—Aircraft manufacturer Airbus is to cover two new A-340 aircraft for Lufthansa and Air France, among others, with ribbed foil. After a three-year long trial using an A-320, it has become apparent that the application of a rugged film considerably reduces air drag and thus fuel consumption. This can produce a saving in fuel of 280 metric tons per year for an A-340.

At first this may seem strange, but it does work. A rugged surface can reduce air drag, a principle which has been copied from the shark. Researchers from the Technical University of Delft, among others, have been experimenting carefully with the phenomenon. It seems that the principle applies to aircraft and also to boats and racing cars. Tests carried out by Airbus with an A-320 have produced such positive results that wider applications are now being looked for.

The reduced drag (air or water) is attributable to micro-turbulence phenomena at the material's surface. These "low-speed streaks," as they are called, produce a certain drag even on a smooth, glassy surface. A ribbed surface structure apparently has a drag-reducing effect on this turbulence phenomena.

In tests with the A-320, 70 percent of the surface area of the aircraft was coated with a ribbed foil which had been especially developed by 3M. It appeared to be able to reduce fuel costs by almost 2 percent.

The matter is rather more complicated for the A-340. For the time being it will not be 70 percent, but only 30 percent of the aircraft's surface which will be covered

with foil. Engineers from Aerospatiale, which participates in Airbus, think that it will still be possible to produce a fuel reduction of about 1 percent. An A-340 uses about 28,000 tons of fuel per year.

**Projects on Eureca Space Platform Described**

*BR1506083893 Paris ESA (EURECA RETRIEVAL SPECIAL) in English May 93 p 2*

[Text] After more than 10 months of operation in orbit, the 15 experiment facilities carried on the Eureca platform (five of them multi-user) have made it possible to conduct 71 experiments under the responsibility of researchers from the ESA Member States. The bulk of the targets set for the orbital part of the mission have been met or have been exceeded.

The second phase of the mission will take place on the ground, once Eureca has been retrieved and the experiments have gone back to their home laboratories, where they will be analyzed at the same time as the results obtained are being sifted. This will be the first time European experiments have been retrieved and brought back to earth after several months in space.

**AMF (Automatic Mirror Furnace)**

This optical-radiation furnace, the first in a new generation of crystal growth facilities equipped with devices for changing samples and lamps, has allowed 21 experiments in growing uniform monocrystals from the liquid or vapour phase (crystallisation of CdTe and CdSe from the vapour phase; PbSnTe, InP, CdTe, GaAlSb semiconductors from solvent zone, and directional solidification of GaSb and GaSb-ZnSb in rough crucibles). The furnace ran in automatic mode until 26 January 1993, when it was shut down at the end of its experiment cycle.

**SGF (Solution Growth Facility)**

Made up of four reactors for growing monocrystals from solutions, this multi-user facility hopefully made it possible to produce crystals of amorphous tricalcium phosphate, calcium carbonate and zeolites (aluminium silicates). One reactor, divided into 20 separate test-tubes, is designed to measure Soret coefficients (the ratios between thermal and isothermal diffusion coefficients.) These four reactors have worked well until final deactivation at the end of March.

**PCF (Protein Crystallisation Facility)**

Intended for the growing of high-quality protein monocrystals from solutions, this multi-user facility has 12 reactors which have succeeded with their objectives. Good crystals are clearly visible in five reactors in spite of a transient and unintended temperature excursion of the facility. The crystallisation phenomena have been watched from the ground through video cameras. All crystals which measure a few fractions of a millimetre will be studied. The molecular structure of the monocrystals will be analysed using X-ray diffraction.

#### **MFA (Multi Furnace Assembly)**

The 12 furnaces, of three different types, making up this modular, multi-user facility have worked perfectly, and allowed a series of experiments in materials sciences covering the growth of semiconductor crystals, the phenomena of wetting between solid ceramics and liquid alloys, liquid phase diffusion and sintering phenomena. During the mission in orbit this facility was used, for power saving reasons, in sequences in which only one furnace was operating at a time, and it was shut down when the cycle of operations ended.

#### **ERA (Exobiology and Radiation Assembly)**

This multi-user facility for studying the effects of the space environment on organic materials is fitted with deployable trays and cylindrical compartments containing biological samples (spores, seeds and eggs) and radiation detectors. During the mission the samples have been exposed to the various components of the space medium for predetermined times. The duration and type of this exposure were controlled using shutters and filters, and examination of the samples once Eureca is back on earth will allow modelling of the action of heavy ions on tissues, of inactivation and mutagenesis due to solar radiation, of the effects of solar UV rays on molecule formation and destruction, and of the composition of cosmic radiation in the platform's environment.

#### **HPT (High Precision Thermostat)**

This equipment was designed for long-duration microgravity experiments under extremely accurate temperature control (approx. 0.001 degrees K), and has been used to study the isochore adsorption of sulphur hexafluoride (SF6) close to its critical point at the surface of a chemically-inert solid (in this case, graphisited carbon)—the critical point is the point of temperature and concentration at which there is no difference in the density of the fluid in the liquid and vapour states. Five cycles each of over a month have been completed (two more than was planned); analysis of the data transmitted during the mission has already revealed negative adsorption close to the critical point, similar to that seen on earth and attributed up to now to the effect of gravity. Final conclusions cannot however be drawn until the experiment is back on earth.

#### **SFA (Surface Forces Adhesion Instrument)**

This experiment package has been designed to study the dependence of surface forces and interface energies on physical and physico-chemical parameters such as surface topography, surface cleanliness, temperature and the deformation processes of bodies in contact. Despite difficulties in getting it to work during the first part of the mission, the SFA has nearly completed its cycles of experiments, watching the impact of small spherical projectiles against plane targets serving as force transducers. It has been possible to observe the effects of surface forces and energies during the dynamic interaction when a small projectile strikes a

metal target at very low velocity (0.1-2 mm/s); this kind of observation would not have been possible on earth, because of the dominant influence of gravity interactions. It will take several months to analyse the results obtained during the mission.

#### **SOSP (Solar Spectrum Experiment)**

This instrument, fitted with three spectrometers (infrared, visible and ultraviolet) is used for one revolution every two days and has made it possible to measure the sun's absolute irradiance together with its variation in the spectrum range 0.17-3.2 micron; it has yielded high-quality data throughout the mission. The SOSP and SOVA experiments took part in April 1993, in a session of simultaneous observation of solar radiation involving the American UARS, ERBS and Nimbus-7 satellites and the SOLSPEC and SOLCON (designed by the same team as SOSP and SOVA) flown in the Atlas-2 laboratory on Shuttle Discovery.

#### **SOVA (Solar Constant and Variability Instrument)**

This equipment for studying the solar constant (i.e. the amount of energy received from the sun in the earth's orbit) and its variations and spectral distribution comprises two absolute radiometers, a high-precision radiometer and solar photometers, and has measured fluctuations in energy and spectral irradiation over periods lasting from a few minutes to several hours or even months. Unlike past and future measurements, the SOVA will allow study of these variations over a timescale of several years. During the mission, highly accurate data have been obtained, and data-processing algorithms have already been developed for working out from them the absolute value of the solar constant (theoretical value equal 1366 W/m<sup>2</sup>). The effects of solar activity on the constant have also been shown during sunspot periods, which brought about variations of 1 to 2 W/m<sup>2</sup> over 10-15 days. In April, the SOVA took part together with the SOSP in a session of observation of solar radiation involving several other similar instruments flown on US satellites and in the Atlas-2 laboratory on board Shuttle Discovery (see SOSP above).

#### **ORA (Occultation Radiometer)**

To study the density of aerosols (permanent or of volcanic origin) and trace gases (ozone, nitrogen dioxide, water vapour, carbon dioxide and so on) in the earth's mesosphere and stratosphere at 20 to 100 km altitude, this equipment has measured the intensity of solar radiation through the atmospheric limb in ten wavelength ranges (from the ultraviolet to the infrared) as the Sun rose and set. More than 10,000 events (sun sets, sun rises, sun shots) had already been measured by mid-April. The validity of the computer models has already been shown by the values obtained in the visible-light and near-ultraviolet bands. This equipment will carry on working right up to the last few days of the mission.

**WATCH (Wide-Angle Telescope for Cosmic Hard X-rays)**

This instrument for detecting and plotting the position of gamma- and X-ray sources emitting photons with energies between 5 and 200 keV has allowed the discovery and pinpointing of five new X-ray sources. Up to November 1992 WATCH scanned the central regions of the galaxy, and a score of X-ray sources could be observed each day. It has also detected two gamma-ray bursts, one of which in real time. During the final three months of the mission, a dedicated experimental link via the IOC [see below] equipment and ESA'S relay satellite Olympus, has permitted direct reception of data at the Danish Space Research Institute, leading to faster processing and operation of WATCH in coordination with observatories on earth. When the mission is over, the data gathered will help determine the luminosity curves and energy spectra of cosmic gamma bursts, novae, active galactic nuclei and other sources of variable gamma- and X-radiation that have been observed.

**TICCE (Time-band Capture Cell Experiment)**

This passive experiment is meant to capture microparticles moving at more than 3 km/s relative to the platform and to record their impact. The results, which cannot be evaluated until Eureca returns to earth, should allow the study of the various dusts—meteoric or cometary, debris of terrestrial origin, etc.—present in low-earth orbit.

**RITA (Radiofrequency Ionisation Thruster Assembly)**

This experimental ion thruster, intended to assess the performance of this kind of propulsion in Space and gain practical experience of it, operated for 244 hours at varying thrust levels (from 6 to 10 mN). Initially almost 2,000 hours of operation were planned, but overheating of a connector caused a circuit to drop open and put the equipment out of service from 12 September 1992. Despite this premature shutdown, most of the objectives were achieved.

**IOC (Inter-Orbit Communication Experiment)**

This instrument, designed for experiments on and pre-operational demonstration of future data transmission via a network of geostationary relay satellites providing global coverage, has allowed the testing of two-directional data transmission and telemetry from a satellite in low-earth orbit to a ground station via ESA's telecommunications satellite Olympus. IOC was switched on 31 July 1992, even before the platform was released into Space, and has provided over 450 links lasting about 50 minutes each. Trials have been run at the MUSC (Microgravity User Support Centre) at Cologne with a mobile receiver station, on the reception and real-time processing of data; the station was moved to the Danish Space Research Institute in February, 1993, for using the WATCH instrument, and a second station was set up at ESA's research and technology center, ESTEC.

**ASGA (Advanced Solar Gallium Arsenide Array)**

Made up of two small test modules, this experimental solar array was developed to determine the performance of gallium arsenide (GaAs) photocells in various configurations (as panels or in parabolic concentrators). To do this, a measuring unit constantly records the performance and temperature of the photocells and transmits the data to the ground; the results obtained so far confirm expectations. When the platform is back on earth it will be possible to gauge the effect of the low earth orbit environment (damage by radiation) on the components used.

**ESA's INTEGRAL Gamma-Ray Astrophysics Project Described**

*BR1806123893 Paris ESA PRESS RELEASE  
in English 4 Jun 93 pp 1-4*

[Unattributed press release: "INTEGRAL Confirmed as Next Scientific Mission"]

[Excerpts] ESA's Science Programme Committee, meeting at the European Space Research and Technology Centre, ESTEC, in Noordwijk (the Netherlands) on 3 and 4 June 1993, has accepted the recommendations of the Space Science Advisory Committee and confirmed INTEGRAL (International Gamma-Ray Astrophysics Laboratory) as the second "medium-sized" mission (M2) within the framework of the "Horizon 2000" scientific programme.

INTEGRAL is a gamma-ray observatory to be developed in cooperation with NASA and the Russian Institute for Space Research, IKI. The instruments it will carry, 10 to 50 times more sensitive than those previously flown on other spacecraft of this kind, will allow it to greatly push the limits of gamma ray astronomy.

**Mission Scenario**

INTEGRAL's primary mission will be to observe the galactic plane and centre, but it will also be looking into other directions to search for extragalactic gamma-ray sources such as nuclei of active galaxies or clusters of galaxies. Another observing priority will be the study of compact objects (neutron stars, black holes) as well as supernovae and novae. Most of the observing time will be made available to the worldwide astronomy community through a "guest observer programme" for which calls for proposals will be issued. The rest of the mission will be reserved for the research institutes that will develop the payload, i.e., the instruments, and the data processing facilities.

The INTEGRAL satellite will use a platform—the so-called "bus"—identical to that currently being developed for the ESA X-ray Multi Mirror (XMM) cornerstone mission. ESA has the overall responsibility for spacecraft and mission design, instrument integration and testing, spacecraft operations and acquisition of data. Scientific instruments will be provided largely by

the European science community. NASA will supply one or two ground stations and will be involved in the development of instruments, e.g. the spectrometer. Russia will provide a Proton launcher free of charge in exchange for observing time. A parallel option with an Ariane 5 launcher is also considered.

The launch of the 3.6-[metric]-ton INTEGRAL spacecraft is planned early in the year 2001. The Proton launcher delivers the INTEGRAL into a 72-hour orbit with a high perigee of 48,000 km and a 115,000-km apogee at 51.6-degree inclination, while an Ariane 5 launch would inject the spacecraft into a 24-hour orbit with a 4,000-km perigee and 68,000-km apogee at 65 degree inclination. Both launch vehicles would thus make it possible to avoid the disturbance that is caused by high-energy particles trapped in the earth's radiation belts and which actually permits observations to be carried out only at spacecraft altitudes above 40,000 km. The INTEGRAL mission is expected to last two years, but could be extended to five years. [passage omitted]

#### The Next Stage in Gamma-Ray Astronomy

As the next logical step in gamma-ray astronomy, INTEGRAL will fly a payload comprising two main instruments, a caesium iodide imager and germanium spectrometer which are complementary to each other, together with two monitors: a CCD [charge-coupled device] optical transient camera (OTC) and a coded mask X-ray monitor.

The two main instruments will bring major improvements in both spectral and angular resolution of observations. INTEGRAL's instruments will be 10 to 50 times more sensitive than those on earlier missions. This improvement in sensitivity will give access to a substantially increased portion of the universe that is observable in this part of the spectrum.

With its Germanium detectors (which have a much better spectral resolution, and which are more sensitive than counters used so far), the spectrometer will be able to study typical radiation from violent processes in the 15-KeV to 10-MeV region about which little is as yet known: nuclear excitation, positron annihilation and cyclotron emission. The main task of the imager will be observation and mapping of sources with a much improved spatial accuracy and sensitivity. The monitor instruments will study the same part of the sky as the main instruments, but in different bands of the spectrum. The optical transient camera (OTC) could even make it possible for the first time to associate a gamma-ray burst source with a visible object. [passage omitted]

#### SPOT-4 Satellite Wear Experiments Described

*BR1406125393 Paris NEWS FROM PROSPACE  
in English Jun 93 pp 50-52*

[Unattributed article: "Steel Technologies Takes the Measure of Space"]

[Text] The SPOT [Probational Earth Observation Satellite] program committee has accepted certain experiments aboard SPOT 4 in a project known as Pastec. Steel Technologies contributes two of the experiments making up this package.

As part of the French CNES's [National Center for Space Studies] research and technology initiative, the SPOT program committee approved several experiments for the next-generation SPOT 4 remote sensing satellite. Designed to study in-situ the physical parameters that are important for life in orbit or space qualification of hardware for future programs, these experiments have been grouped in a single payload known as PASTEC—the French acronym for technological passenger and a French homonym for watermelon!

Two of these experiments are called CEDRE and MEDY, the French abbreviations, respectively, for "Contamination and Degradation of Coatings in Space" and "Dynamic Measurements." Since 1989, Steel Technologies has been working on the design, development and production of these two experimental packages.

#### CEDRE

The aging of coatings is linked to a series of aggressions that modify their physical and chemical properties. Changes can be traced to several causes, including the presence of a vacuum, the action of the sun, free oxygen atoms and cosmic radiation and dust. The CEDRE experiment will carry out tests directly in the space environment to contribute to a better understanding of these phenomena.

The experimental package features a sensor module supporting four micro-calorimeters (one painted black), two microscales and a solar cell.

The micro-calorimeters enable an assessment of variations in solar absorptivity. By connecting them to the microscales, the microscales can highlight any possible relationships of the coatings to be studied with the emissivity coefficient. The solar cell performs several functions: differentiating the terrestrial and albedo fluxes, and validating the method of calculating the normal solar angle by comparing the flux levels calculated and measured on the SPOT 4 orbit; the second goal of the CEDRE experiment is to evaluate a method of measuring the insolation dose by connecting the black micro-calorimeter to the solar cell.

### Three Principles

The CEDRE experiment can in fact be characterized by three principles.

First, calorific measurement enables analyzing the variations in solar absorptivity.

Second, the contamination measurement principle allows measuring the deposition of contaminants on the coatings. This assessment is based on measuring the beat frequency and temperature of two crystals, one protected and the other exposed to the flow of polluting particles.

The third principle is measurement of the insolation dose. The method used for measuring this dose is based on knowing the angle  $\theta$  of the sun's direction in relation to the perpendicular vector of the sample from the black micro-calorimeter.

### Electronics

Steel Technologies designed and developed the electronic system to meet experimental specifications. It is comprised of four Euroformat boards: microprocessor, multiplexing/conversion, clock/counter and relay board.

The microprocessor board provides full system management, including acquisition, storage, computation and communications. It is built around a 68000 microprocessor, with 64K x 16 bits EPROM [erasable programmable read-only memory], 2K x 8 bits EEPROM [electronically erasable PROM], 128 K x 16 bits SRAM [static random-access memory], RTC [real-time clock], 20 all or nothing I/O [input/output devices], an RS232 interface and a Latchup control system.

The multiplexing/conversion board is fully dedicated to managing the periodic signals and acquiring QCM frequencies. The relay board switches relays that control the three operating modes—measurement, heating, decontamination—for the microscales and micro-calorimeters.

The sensor module measures 219 x 174 x 125 mm and weighs 1.168 kg; the electronics module measures 200 x 160 x 90 mm, weighs 2.743 kg and consumes 2 watts of power.

### MEDY

The MEDY experiment has a two-part mission. Initially, it will measure vibrations and mechanical stresses during the powered phase; next, it will measure the satellite's responses to both natural stimulations and to a calibrated excitation. By carrying out the measurements in flight, results will improve our knowledge of these phenomena, and lead to more accurate modeling in terms of the mass-stiffness aspect and dissipation elements.

The MEDY experiment therefore has two very different operating modes: "propulsion" and "orbital."

In propulsion mode, MEDY will measure the disturbances and mechanical stresses experienced by SPOT 4

during the powered phase. During the 350 seconds under power, some 22 different sensors will be active: 18 Brüel & Kjaer accelerometers and 4 Vishay CEA 13-250U W-35D stress gauges. Data acquisition is performed during five variable length segments distributed over the 350-second period, at characteristic moments such as liftoff and stage separation.

MEDY is designed to measure the vibrations undergone by SPOT during its orbital life. These are produced both by natural stimuli, such as nozzle pulses, inertia wheels, etc., and by calibrated excitations generated by a minivibrator that is frequency- and amplitude-controlled by the experiment itself. The result is two types of measurement: calibrated and overall.

### Calibrated Measurements

By comparing behavior in flight and on the ground, calibrated measurements spotlight changes in dissipation.

The range of frequencies is from 20 to 200 Hz.

The operating principle is sinusoidal control of the minivibrator over the frequency range 20 - 200 Hz at a variable step  $F$  and amplitude  $A$  programmable according to the excitation force selected from among the three possibilities 0.05, 0.1 and 0.5 N.

Since we are seeking the amplitude  $A_r$  and the phase  $Q_r$  of the exciter's frequency component  $F$ , processing is needed to extract the useful information.

Data come from 10 Septa accelerometers and two B and K accelerometers distributed along the satellite's structure. The expected amplitude of the phenomena is from 1 mg to 100 mg, over frequency bandwidths from 1 to 200 Hz.

### Overall Measurements

Overall measurements are acquired by the same sensors as the calibrated measurements. A given measurement will be activated on the theoretical date on which an event should occur. For each sensor and each bandwidth, we have to adapt the full scale to the range of the measurements assumed by the intermediary of programmable gains.

The electronic system driving these different functions is a unit comprising seven Euroformat boards: microprocessor, conversion, two propulsion phase acquisition boards, two orbital phase acquisition boards, and a minivibrator control board.

This unit measures 204 x 170 x 152 mm, weighs 3 kg and consumes 11.1 watts during propulsion phase and 18 watts during the orbital phase.

The microprocessor board is the same as for CEDRE, except the memory is set at 1 Mb. The conversion board performs 16-bit digitization of the signals from the propulsion and orbital acquisition boards.

Both propulsion phase acquisition boards support the power electronics for the sensors, and the amplification,

filtering and multiplexing of signals. The two orbital phase acquisition boards support the power supply electronics of the Septa sensors, and the programmable signal filtering, amplification and multiplexing.

Finally, the exciter control board drives the amplitude and frequency of the minivibrator. It generates excitation force instructions from 0.01 to 0.5 newton, and at frequencies from 20 to 200 Hz, in variable steps from 0.02 to 0.2 Hz.

Frequency band	Number of sensors	Expected range	Forecast ranges
0-20Hz	10	approx. 5 mg	approx. 1 mg - 10 mg
20-200Hz	10	approx. 500 mg	approx. 100 mg - 1000 mg
20-2000Hz	1	approx. 5 g	approx. 5 g

### France: Sextant Avionique's Space Imaging Developments Outlined

*BR1406130693 Paris NEWS FROM PROSPACE in English Jun 93 pp 69-70*

[Unattributed article: "Sextant Avionique: The European Leader in Imaging System Electronics"]

[Text] Sextant Avionique is one of the world's leading designers of high-performance video signal processing electronics, a key part of today's amazing remote sensing spacecraft.

Electronics by Sextant Avionique equip a number of European remote sensing satellites, including SPOT 1 to 4 [Probational Earth Observation Satellite] and Helios 1, as well as scientific spacecraft such as Adeos-Polder and Mars 94-Evril.

New developments are now underway with support from national and European space organizations. Once the feasibility studies have been completed, these new electronics will become an integral part of the image processing systems onboard Spot 5, Helios 2, Metop-IASI, etc.

The spaceborne image and signal processing systems of the future require very high-performance features. But Sextant Avionique will be able to meet this challenge thanks to enhancement of critical functions such as the operational amplifiers, high-speed analog switches and analog-digital converters, as well as advanced microelectronic techniques, including analog ASICs [application-specific integrated circuits]. Tomorrow's image processing instruments will therefore offer higher performance, in terms of both Megapixel rates and digital data rates.

Sextant Avionique has extensive signal processing experience covering high-speed acquisition and processing of wideband low-level analog signals from DC to tens of MHz and beyond. These signals are sent from the instrument sensors, whether CCDs [charge-coupled device], photomultipliers, transducers, etc., to the signal processing units.

### More PASTEC

Steel Technologies also contributes to the PASTEC experiment in other ways. It is for example, in charge of the design and production of the wiring harness interconnecting the different experiments and the Servus module that provides power supply and the general management of measurement control and acquisition. All in all, a lot of work for a "watermelon" in space.

Low-level functions such as filtering, multiplexing and amplification, in association with the detectors, require a wide range of analog signal processing performance. On the other hand, analog-digital converters up to 15 bits, compression formatters, scrambling, encrypting and other sophisticated functions incorporated in new-generation spacecraft require high computing power based on digital signal processing technology.

Sextant Avionique brings to bear its wide range of skills in onboard high-speed signal processing. The company's expertise ranges from the design of critical components, such as hi-rel wideband amplifier hybrids and ASICs, to the precise characterization subassembly features.

The design and production of hi-rel devices for operation in space is based on in-house microelectronics expertise, including thick film hybrid and ASIC technologies qualified by the European Space Agency and CNES, France's national space agency.

Based on these proven capabilities, Sextant Avionique has been extensively involved in the development and fabrication of space electronics. In particular, it produced the video signal processor modules used with the push-broom type instruments on SPOT and similar earth observation satellites.

### Applications

For the SPOT 1 satellite, Sextant Avionique designed and produced two video signal processing units for the two HRV (high resolution visible) instruments, including the multi-spectral and panchromatic channels on each instrument.

For SPOT 4, the latest satellite in this successful series, Sextant Avionique has designed and produced video signal processing units for the two HRV-IR (infrared) instruments.

Each video signal processing electronics unit on SPOT 4 weighs 26 kg and contains 35 circuit boards. Its main functions are analog processing and encoding,

sequencing for the whole imaging system, data processing (including dating, resolution changes, data formatting), onboard calibration and power supply for the whole imaging system.

For the Helios 1 military observation satellite, Sextant Avionique has delivered the video signal processing electronics and the power supplies for the instrument's imaging system.

Sextant Avionique also supplies the video signal processing electronics for the French Eris experiment to be carried aboard Russia's Mars-94 probe. The company also supplies the electronics for the French Polder experiment on Japan's Adeos satellite.

In short, Sextant Avionique makes a major contribution to both civil and military earth observation satellites, with equipment for both platform and payload. Its participation in these programs spans the range of the company's electronic skills, including onboard data handling and processing, power conditioning and distribution, signal processing and instrumentation.

It doesn't take a close-up image to see that Sextant Avionique is indeed one of the leaders on the European remote sending stage.

[Box, p 70]

#### Sextant Avionique Acquires CIR of Switzerland To Reinforce Its Position in Space Electronics

On January 29, 1993, Sextant Avionique signed an agreement with ACMV Vevey Holding SA of Switzerland, to acquire the Swiss equipment manufacturer CIR (Compagnie Industrielle Radioelectrique).

CIR primarily produces equipment for space applications (microgravity, time counters, payload testing, ranging, remote control, etc.), in particular for European Space Agency programs. In 1992, CIR posted sales of approximately 25 million French francs.

For Sextant Avionique, European leader in onboard space electronics, this acquisition falls within the scope of a business growth strategy. For CIR, the leading Swiss manufacturer of space equipment, the technological contributions and industrial support of its new shareholder will allow it to consolidate its position as a space equipment supplier and enter new markets.

## BIOTECHNOLOGY

#### Germany: Field Trials With Genetically Modified Plants Planned

MI1207092693 Bonn DIE WELT in German  
14 Jun 93 p 12

[Text] The Institute of Plant Genetics and Cultivated Plant Research (IPK) in Gatersleben intends to apply for permission to perform field trials with genetically modified cultivated plants. Preparations have progressed to

the point where tests can begin no later than next year, said managing director Professor Ulrich Wobus.

One of the products concerned is a potato with a genetically modified metabolism, which is to be tested for stress resistance under environmental change. The scientists also intend planting a relation of the bean with improved seed protein quality, approaching that of animal protein. The tests are intended to establish how the plants behave under day/night alternation and under natural weather influences. So far there have been only three trials involving the release of genetically modified plants in Germany.

## COMPUTERS

#### SGS-Thomson Introduces Inmos T9000 Transputer

93WS0500A Frankfurt/Main FRANKFURTER ZEITUNG: BLICK DURCH DIE WIRTSCHAFT in German No 95, 8 May 93 p 8

[Article from P.O., London]

[Text] It is hard to imagine a greater contrast than that recently on display in London. The new Inmos T9000 microprocessor was exhibited amid historical ceramics in the Victoria and Albert Museum in the British capital. The multinational SGS-Thomson consortium had purposefully arranged it so, because the T9000 is explicitly regarded by its designers as an also equally epoch-making advancement.

Development of this microprocessor, up to delivery of the first designed prototypes a few weeks ago, took altogether three years. This period of time was praised in London as a "remarkable" one by Pasquale Pistorio, president of SGS-Thomson Microelectronics. A few individual potential buyers commented at the same time that the transputer was overdue after all, a reproach which Inmos representing in Great Britain the consortium responsible for its development will emphatically not accept as valid. Ian Pearson on the Inmos board of directors characterizes the T9000 transputer, which contains 3.3 million transistors, as the world's fastest single-chip computer with a peak capacity of 200 Mips (million instructions per second). It performs 25 million floating-point operations per second and has not only a 64-bit floating-point unit but also a 32-bit superscalar-integer processor and a virtual-channel processor.

All these components are packed into one chip only 10x20 mm<sup>2</sup> large. It is reported that the new tungsten plugs have been found to be eminently suitable for interconnecting individual layers of such extremely small dimensions in the chips. Both the Inmos Company and the parent company also point out the exceptionally good "balancing" of computation and communication capabilities. As a further special attraction is cited the low power consumption of only 3 W, as long as no external storage system are used in the operation.

The emphasis on that balancing of computation and communication capabilities suggests that Inmos is counting on an outright extremely fast growth in mobile communication equipment within the coming years,

whether it be individual units or components of computers and of automatic navigation systems or any other such devices.

For nearly all other applications Inmos also proceeds from the premise that a high transmission capacity is needed. This concerns, for example, not only the T9000 for data banks but just as well the T9000 for color facsimile equipment, multimedia, and many other applications. A just as fast growing demand for so-called parallel processing is anticipated by Inmos. For this application particularly Imos considers the possibility of integrating the T9000 with other transputers.

#### Bus Coupling not Anymore a Bottleneck

Special high-speed intersection sites integrated on the chip make it possible to build microprocessor systems in which the usual bus coupling would constitute a bottleneck and therefore be rejected. This makes possible a linear buildup of capacity when a network of transputers is being formed.

Of the less powerful transputers earlier sold by Inmos, 80 percent were used for so-called Embedded Control rather than been installed in computers. Inmos anticipates that use of the T9000 transputer will continue in the same 8:2 ratio. The absolute number of transputers likely to be used in computers is, however, rapidly increasing: While of all transputers built since 1985 only 1 million was sold and thus at first only 200,000 units were installed in computers, the second million of them will presumably be offered for sale within just the next two years.

In this way the absolute number of transputers in computers will increase much faster than it had before. In the current year Inmos is increasing the production of T9000 transputers from 30,000 to 40,000 units, while the older models will continue to be built at the same time.

Still more units are then also to be produced beginning next year, because the manufacture of the T9000 will be transferred from the Inmos Production Works (sold) in Newton near Bristol to France near Grenoble where SGS-Thomson has built new plants. At any rate, more than 100,000 units of the T9000 are to be manufactured in 1994. This, according to data reported by the management, will lead to a rapid price reductions.

#### Beginning of a Transputer Line

Whether SGS-Thomson or Inmos remains responsible for the development and the application engineering support within this combine, notwithstanding the sale of the old microprocessor manufacturing plant, both regard the T9000 not as a singular product but rather as the first step toward a new transputer line which will already in this decade reach the goal of 10 million transistors per chip.

Announcements made by a number of customers concerning future applications for the T9000 confirm the

great interest which, as the London group claims, buyers have in this microprocessor. For instance, Ferranti will use the T9000 as the main processor in a new submarine tracking sonar and the Parsytec GmbH in the Federal Republic is getting ready to use the T9000 for parallel processing of scientific data in desktop computers.

A new generation of Database Servers using the T9000 is being planned by White Cross Systems, while Pacific Parallel in the U.S. is already offering an interface for the T9000 with the Macintosh computer and Motion Media in Great Britain use the T9000 for its own display telephone.

#### Germany: Developments in Fuzzy Logic Programming Reported

93WS0543A Frankfurt/Main FRANKFURTER ALLGEMEINE in German 16 Jun 93 p N4

[Article by Anne Hardy: "On the Uses of Imprecision: Fuzzy Logic in Control Technology and Data Analysis"]

[Excerpt] [passage omitted] Hans-Juergen Zimmermann, holder of the chair for business research at the Technical University in Aachen, first became interested in Zadeh's work in 1972. As the publisher of the first international magazine on the subject "Fuzzy Sets and Systems," and as the founder and initiator of numerous consulting agencies, Zimmermann from early on has encouraged Europeans to join together in joint research work. As the counterpart to the Japanese Institute "Life" [Laboratory for international Fuzzy Engineering Research], which was designed to facilitate the transition of fuzzy developments from the laboratory into practice, Zimmermann, in 1991, established "Elite" [European Laboratory for Intelligent Techniques Engineering]. At about the same time, he was also instrumental in having the State of North Rhine Westphalia establish the Fuzzy Initiative NRW, where Bernd Reusch, Harro Kiendl, and Hubert Frank of Dortmund University, together with the Siemens AG and the MIT [Management of Intelligent Technologies] Association, also founded by Zimmermann, will explore the possible applications of the new technology and promote the practical use of their research results.

#### Laser Cooling

Examples of applications of fuzzy logic that have already been introduced were recently exhibited in Duesseldorf by the VDI [Association of German Engineers] in an adult education display. The Uranit Company of Juelich, for example, reported on the development of a "fuzzy regulator," that can control the cooling of an industrial laser more economically and even better than the hitherto existing systems.

A pulsed carbon dioxide laser can, among other things, be used to line beer glasses. In order to keep the laser functioning, the cooling system has to be able to eliminate the short-term heat build-ups that result from gas discharges. In addition, it has to be able to adapt to the

different speeds of the conveyor belt. The engineers have satisfied these requirements by adding a module to the computer's already existing real-time system that is able to "understand" fuzzy values.

### Simpler Quality Control

For the first time ever, the Hoechst Company—by using a "fuzzy regulator"—was able to control the properties of polyethylene during its synthesis in the reactor. This plastic, which, among other uses, can be drawn into foils of just a few thousandths of a millimeter thick, can also be produced with the same high quality. Before the "fuzzy regulator" was used, the chemical process could only be assessed by means of costly quality controls. It often took several hours to take and analyze a sample.

MIT in Aachen offers services to industrial users. Fuzzy data analysis helps in the maintenance of facilities that process light gasoline. To prevent damage, the pipes of the furnace have to be removed at regular intervals and cleaned. To know when it is time to do this, the operators have commissioned a program for data analysis. Meanwhile, the MIT Company, as part of an EC project, is studying similar tasks in so-called intelligent sensor technology relating to material fatigue in power stations, bridges, and oil platforms.

Hans-Juergen Zimmermann believes that further developments of "fuzzy technology" in Europe will depend on the quality of the cooperation between the separate European research groups. The amount of Government support in Europe is small compared to that in Japan the United States. With the exception of "Elite" and the "Fuzzy Initiative NRW," hardly any other efforts are being expended to promote practical applications of fuzzy technology.

## ENERGY, ENVIRONMENT

### Germany: Thermoselect Waste Disposal Process Described

*MI1106102093 Munich SUEDDEUTSCHE ZEITUNG  
in German 6 May 93 p 38*

[Article by Christa Friedl: "A Blow for Waste Management Liberation? New Process Will Eliminate Waste Without Pollution While Also Supplying Energy"]

[Text] A new buzzword is currently making the rounds of German waste disposal experts: "thermoselect." This is a process that converts waste of any and every kind into a harmless vitreous residue. If the claims of the eponymous operating company based in the Italian town of Fondotoce are to be believed, the process produces virtually no pollution, waste gases, or effluents, and also supplies energy.

Thermoselect's claims seem to promise liberation from the realities of Germany's waste disposal scenario. Existing waste incinerators are overstretched, while public protests are virtually preventing the licensing of

any new ones. The same applies to waste dumps, with the result that Hamburg's head of waste disposal, Hans Moenninghoff, predicts that in five years one two [as published] German municipalities will have hardly any space left for waste disposal. "Therefore there is an enormous need for a new, economical, and reliable process."

The scale of the problem can be seen in Fondotoce, where several hundred local politicians, environmentalists, and experts, overwhelmingly from Germany, are observing the month-by-month operation of the first pilot plant near Lake Maggiore. What these potential customers have seen is the intelligent combination of two processes, each already familiar in its own right: low-temperature carbonization of waste (pyrolysis) and high-temperature gasification.

The first stage is compression of the waste to one-tenth of its volume in a 1,000-tonne press, releasing air and water. The waste briquettes then pass through a 15-meter degasification channel, where they are carbonized in an oxygen-free environment at temperatures of up to 600° C. After two-and-a-half hours, the organic constituents have been converted into carbon. Pyrolysis gas is also produced—a mixture of methane, carbon monoxide, carbon dioxide, water vapor, acids, and sulfur hydrides.

Thermoselect provides a simple solution to a problem central to pyrolysis: The highly-compressed waste briquettes act as a plug at the entrance to the degasification channel, preventing atmospheric oxygen from penetrating the plant and interrupting the carbonization of the waste. As air is thus excluded, virtually no nitrogen oxide is produced, thus obviating the need for subsequent denitrification.

In the second stage of the process, the carbon, mixed with the mineral and metal content of the waste, enters the high-temperature reactor. An oxygen flame produces temperatures of up to 2,500° C, gasifying the carbon, melting the metals and minerals, and decomposing the hydrocarbons. In a second furnace, metals and minerals separate at temperatures of 1,800° C. Both melts cool in a water bath, leaving a mixture combining all the metals from the waste in black, vitreous granules.

The synthesis gas is also abruptly cooled to 90° C, and purified in several washes. This shock cooling is intended to prevent the formation of chlorine and oxygen, dioxines and furanes from organic constituents. The purified gas—predominantly carbon monoxide and hydrogen—is used to generate electricity in downstream gas-fired engines, and for heating the pyrolysis channel.

### Experts Impressed

Rudi Stahlberg, head of research at Thermoselect, finds that experts are always impressed by the pilot plant's provisional materials balance, whereby one tonne of domestic waste produces around 260 kilograms of mineral slag for use in road building, 30 kilos of recyclable metallic mixture, 20 kilos of salts and gypsum, two kilos

of heavy metal concentrate, and 500 cubic meters of high-energy synthesis gas. Stahlberg says that, as the entire process runs continuously, without any energy loss from cooling and reheating between the separate stages, "a tonne of waste leaves a residue of 259 kilowatt hours of electricity."

Numerous experts have examined Thermoselect's claims during the past few months, including the Essen-based German Project Union (DPU), which has carried out a specialist audit on behalf of the Baden-Wuerttemberg and Rhineland-Palatinate environment ministries. DPU managing director Reinhard Schultz came up against various unanswered questions and unresolved technical problems. For instance, the corrosion and durability of the construction materials, which have to withstand continuous operating temperatures above 2,000° C, require investigation. Nor has Thermoselect yet presented a definitive materials balance. According to the DPU, the plant is inadequately equipped from the point of view of safety to handle the explosive synthesis gas and oxygen, and this would prevent licensing for operation in Germany.

The adverse image of conventional waste incineration, arising from the waste gases emitted, is certainly a major factor in Thermoselect's favor. The DPU's figures show that, compared with a modern fluidized bed incinerator, the pilot plant emits only one-fifth as much exhaust gas, and less acids, dust, and sulfur hydrides. Flue emissions of cadmium and other heavy metals, however, are 10 times higher. Dioxines and furanes were also detected in the exhaust gas, contrary to Thermoselect's claims, albeit only in concentrations of a 10th to a 100th of the prescribed German limit of 0.1 nanograms (1 billionth of a gram) per cubic meter of waste gas.

The second major advantage is the fact that the granulated residues can be recycled without any further treatment, whereas dust and slag from fluidized bed incinerators have to be treated at high temperatures before they can be used or dumped. According to Bernt Johnke of the Berlin-based Federal Environment Agency (UBA), "Thermoselect clearly aims to convert waste into inert material suitable for dumping." It still remains to be established, however, whether the granulates can also be used for building: "Competition on the rubble market is fierce at present," says Moenninghoff. However, there would be little risk attached to dumping the vitreous waste, as it is virtually free of organic constituents; this makes Thermoselect's arrival on the scene well-timed, in view of the new Technical Directive on Urban Waste, which came into force at the end of April and from now on permits the dumping of waste only if it is thermally pretreated and has an organic content not exceeding 5 percent.

It will undoubtedly be some time, however, before Thermoselect begins to make a mark on Germany's waste mountains: Reinhard Schultz brings realism to bear on over-optimistic expectations, pointing out that "the process is by no means completely safe at present,

and will require several years' development before it is ready for large-scale operation." A similar conclusion has been reached by the Freiburg Institute of Environmental Chemistry, which has described the process as "neither the work of the devil, nor a miracle machine" in a study undertaken on behalf of the German Environment and Conservation Association (BUND). For all that, the process is more environment-friendly than incinerating waste in a conventional rotary kiln or by grate firing.

The experts agree that the very small pilot plant's one year of operation is insufficient for a conclusive verdict as to the process's suitability for large-scale operation. The operators realize this, and have commissioned the Rhineland-Westphalian TUV [Technical Monitoring Board] to investigate what technical improvements would be required in terms of safety, exhaust gas purification, and effluent treatment, to render the process legally eligible for licensing in Germany. The board intends to present its findings by the fall. Regardless of the questions that remain unanswered, Baden-Wuerttemberg, which is struggling to cope with a particularly acute disposal problem, has already clutched the straw held out by Fondotoce: A Badenwerk subsidiary has contracted with Thermoselect to provide only this process in future.

Nevertheless, Thermoselect risks becoming a step backwards in terms of waste disposal policy. Around 2,000 tonnes of ungraded raw waste have been processed to date in Fondotoce; however, it would only be used for residual waste, left over after high-energy constituents such as paper, glass, plastics, and biological material have been largely removed, in Germany. Thermoselect's publicity claim that the process can handle any waste has had an effect in Italy: The nearby town of Verbania has ceased to collect paper and glass separately.

#### Netherlands: Photocatalysis-Based Water Purification Process Developed

*BR1905145293 Rijswijk POLYTECHNISCH WEEKBLAD in Dutch 7 May 93 p 3*

[Article by Bart Stam: "New Technology Purifies Waste Water With UV, ultraviolet, Light—TNO, Netherlands Institute for Applied Scientific Research, and the University of Groningen Avoid Use of Microorganisms and Chemicals]

[Text] Photocatalysis is a new method to purify polluted water. Via a process of oxidation, UV [ultraviolet] light and a catalyst can render dyes, detergents, and biocides harmless. The TNO's [Netherlands Institute for Applied Scientific Research] Institute for Environmental and Energy Technology (IMET) and the University of Groningen want to develop an operational system by mid-1996. This purification method uses no chemicals or microorganisms.

"Photocatalysis is a new technique which is used virtually nowhere else in the world," says J. W. Assink, who

works in the environmental technology department of TNO-IMET. "The technique is still at the laboratory stage. It is true that Nutech in Canada is already supplying commercial units, but they are still far from satisfactory." Assink is head of the photocatalysis project, which should produce an operational prototype within three years. While IMET is aiming to improve the catalyst, the Technical Chemistry Faculty in Groningen is developing the reactor.

Photocatalysis was originally developed for solar energy systems. Over the past two years, IMET has been studying the feasibility of this technique for water purification on behalf of the Netherlands Association of Energy and the Environment (NOVEM). When it became clear that photocatalysis was indeed a viable process, a test model for large-scale applications was developed as a follow-up project.

### Best Properties

The Apeldoorn research team uses titanium dioxide (TiO<sub>2</sub>) as the base material for the catalyst, which, according to current views, provides the best properties. "In the next few years we will try to refine the catalyst," said Assink, "by improving its activity and selectivity. The activity of the catalyst can be increased by improving the efficiency of the incident photon beam to which it is subjected. The current efficiency rate is only 1 percent, but if we can develop a TiO<sub>2</sub> catalyst with a 5-percent efficiency, photocatalysis would compete with a conventional technique such as active carbon absorption."

To boost selectivity, the TNO project leader says that the absorption properties of the catalyst's surface have to be improved. The energy source used by IMET in the experiments is a normal solarium-type fluorescent lamps. UVA radiation with a wavelength of 360 nanometers provides the best energy yield.

The research being performed by the TNO and the University of Groningen forms part of the Innovative Environmental Technology Research Program. Between now and 1996, the project will cost approximately 2 million guilders. The lighting division of Philips has now joined in the research. Negotiations are still underway with three major chemical companies, whose identity Assink prefers not to reveal.

### Water Bills

The interest from industry is mainly inspired by the possibility of reducing water bills. If the method works, waste water can be reused in sectors which require high-quality process water.

### Germany: Organic Tunnel Composting Process Described

MI1806143193 Munich SUEDDEUTSCHE ZEITUNG  
in German 10 May 93 p 41

[Article by Axel Winterstein: "Humus From Garbage—Mushrooms Show Research the Way—Experiments With New Tunnel Composting Method Prove Successful"]

[Text] The container section of the garbage truck is painted green rather than orange, probably to indicate the contents, which are unloaded every two weeks at a rural site in the hinterland of Dachau. It is organic waste. True, it looks like dirty brown domestic waste, but it contains no pollutants, making it ideal for recycling, rather than for costly disposal by dumping or incineration like domestic waste.

At the site to which the green truck brings its load, a recycling method completely new to Germany is being tested: tunnel composting.

A closed system is used to turn the trash, within four weeks, into a valuable humus with an earthy smell, which can be used as a soil mulch in agriculture and horticulture, as a fertilizer, or for recultivation projects on covered sections of dumps.

### More Fresh Material

The pilot composting plant on the edge of the village of Jedenhofen near Markt Indersdorf has been operating since January. Experience is being gained with a view to building a large-scale plant later, like one with an annual processing capacity of 70,000 tonnes that has been operating in Holland for about three months. The pilot plant in Jedenhofen processes about 25 tonnes of organic waste a week, i.e., 1,300 tonnes a year, the equivalent of 25 to 30 percent of the organic waste created in the Dachau district. There is another pilot plant in Austria.

The method derives from mushroom cultivation, where humus obtained from horse dung in similar tunnel-like, closed areas has proved an ideal growing medium for mushrooms.

The Munich-based "Baumann-Schnappinger Waste Industry Planning Association," together with the "Dachau and Fuerstenfeldbruck Districts Nonprofit Waste Disposal and Reprocessing Company" (BfA), proposed the method to the Dachau local authority when the organic trashcan for separate organic waste collection was introduced there in December 1992, as this meant that largely unadulterated organic waste was available for processing with a view to reutilization. Each household now has two trashcans, one for organic waste and one for other waste, unless the householder's own ability to compost it has been demonstrated.

The planning office designed the pilot plant and is now providing scientific consultancy. The BfA, which is owned by the districts named in the title, is the operator.

The plant, which is on a dump site near Jedenhofen, comprises five white-painted sealed containers, each 12 m long. The decomposition process takes place in three of the five containers. The fourth contains the monitoring and ventilation equipment, and the fifth a biofilter.

In front of the three decomposition containers is a small storage area for the delivered biowaste, which is then carried by a wheel loader to a conveyor belt that distributes it initially to two of the three decomposition containers.

Here, it is mixed with texturing material [Strukturmaterial], usually wood chippings, to ensure good aeration. "The texturing material comprises about 15 percent of the volume," explains Johann Baumann, "but our aim is to dispense with texturing material altogether."

Microorganism activity triggers an intensive decomposition process that lasts approximately two weeks and reduces the waste to about 50 percent in both volume and weight.

This decomposition-induced shrinkage makes it possible to combine the material from the two containers in the third decomposition container, the material being moistened and mixed again in the process. This also makes room in the two emptied containers for more fresh material. The old material then undergoes secondary decomposition for another two weeks.

The humus is then ready, and only bigger pieces of wood and any non-rotting items such as plastic bags and drinks spoil the attractive appearance of the compost. The pieces of wood, which cannot disintegrate in a period of only four weeks, are again added to a consignment of fresh material, and the plastic and metal are screened out.

"There are still people," says Baumann sadly, "who throw their organic waste into the organic trashcan in a plastic bag without realising that plastic is not biodegradable. For the drinks cans, we would probably have to have a magnetic separator to extract the metallic parts from an industrial-scale plant."

#### Exhaust Air in Biofilter

Overall, however, the Dachau people are extremely efficient at the separate collection of biowaste, says Dachau district council chairman Hansjoerg Christmann, according to whom the desired industrial-scale plant would be best located close to the Dachau/Karlsfeld conurbation to avoid an excessive increase in traffic transporting the organic waste, although there were problems with this location.

The crucial advantage of the new method in use at Jedenhofen is that the decomposition process can be much better controlled in enclosed spaces than in conventional composting methods. Being controlled, the

cycle is shorter—only four weeks as compared with eight or often 12 with open composting.

Furthermore, tunnel composting is extremely compact and needs very little space, which is an important cost-saving factor. Finally, at least small plants like the one at Jedenhofen need no extra shell, especially as there is no smell nuisance for the neighborhood. Although malodorous exhaust air is produced during decomposition, it is drawn off and pumped away by the biofilter, which filters out up to 98 percent of the malodorous substances.

In the Dutch industrial-scale plant, however, the tunnel components and storage area are located inside a hangar, which could well be introduced in Germany too for plants of a similar size.

The biofilter owes its name to the entirely natural filtration material used: root wood, which lasts a year to 18 months.

As with almost every technology, however, the problems in tunnel composting arise from the minor details. The shortest possible decomposition period, which makes for a high throughput rate and economic operation, is possible only if optimum environmental conditions are created for the microorganisms. At every point of the decomposition process, the material must be neither too damp nor too dry, and the air flow must be constant at all times.

#### Germany: Thin-Film Technology Reduces Cost of Solar Power

*MI1406143793 Munich SUEDDEUTSCHE ZEITUNG  
in German 13 May 93 p 36*

[Text] By 2010, a kilowatt hour of electricity could, as previously reported, cost only 0.66 German marks [DM], according to a study by Bayernwerke in collaboration with RWE [Rhineland-Westphalian Electricity Works] Energy and Siemens. A kilowatt hour generated by solar cells currently costs around DM2.

The authors of the study based their findings on the use both of crystalline silicon, a tried and tested high-performance material, though expensive to produce, and also of thin-layer tandem technology using the less expensive copper indium selenite. Using silicon, the researchers expect 16-percent efficiency (against the present 14 percent); using thin-layer technology, they expect 18 percent (against the present 6 - 8 percent). They studied small-scale systems installed on houses, medium-sized 100- or 500-kW installations, and isolated plants not linked to the grid and therefore requiring batteries for power storage. For all three types, thin-film technology proved superior to silicon: According to the study, small-scale systems came out best, with one kilowatt hour (kWh) costing DM0.66, followed by 100-kW plants, for which the figure was DM1.0 per kWh. Isolated plants were less efficient, the lowest cost being just DM4/kWh (compared with DM5 to 6 today).

Bayernwerke's figures for 2010 thus come close to the prices forecast by the Boekel Foundation of Munich. However, the figures cannot be directly compared. In a study published in 1988, the Foundation calculated that, assuming a 10 megawatt power station were built each year with the technology then available, solar electricity would cost between DM0.50 and 0.70 by 1993.

### Germany: Alternative Solar Cell Materials Studied

*MI1406142993 Munich SUEDDEUTSCHE ZEITUNG in German 13 May 93 p 33*

[Text] Scientists have succeeded in increasing from 7.3 to 10.2 percent the efficiency, i.e., the energy output, from a thin-film solar cell made of copper, indium, and sulfur. Researchers at the Berlin Hahn-Meitner Institute, together with colleagues from Stuttgart University's Institute for Physical Electronics, have achieved this value under normal light conditions and without any special optimization, such as an non-reflecting film.

Photovoltaics has long been looking for materials which can compete with silicon and be produced inexpensively. One alternative is seleniferous copper-indium cells, the toxicity of which has hitherto prevented their use. In comparison, sulfur compounds are largely nontoxic, besides being very inexpensive and having a theoretical optimum efficiency similar to that of silicon. However, little research has hitherto been devoted to this material, so it has the disadvantage that optimizing production is likely to be expensive.

### Germany: BASF, Fraunhofer Institute Develop CFHC Substitute

*MI2306091393 Munich SUEDDEUTSCHE ZEITUNG in German 13 May 93 p 36*

[Article by Olivia Meyer: "Thermal Insulator With Lots of Air—Aerogel, a CFHC Substitute, Can Now Be Made in Bulk"]

[Text] If a jelly-like substance, like custard or a jellyfish, dries out, it becomes wrinkled and cracks form on its surface. About 60 years ago, the American chemist Samuel Kistler managed to stop this decay. He used his process to create new materials, which he christened "aerogels" because they consist mainly of air. One of these airy substances' possible applications derives from the fact that they are good thermal insulators and could therefore replace plastics expanded with CFHC's [chlorofluorohydrocarbons]. Hitherto, aerogels were a research laboratory curiosity. Now, BASF in Ludwigshafen can make them in bulk.

Aerogels get their thermally insulating properties from their extremely fine structure. With a diameter of only a few nanometers (millionths of a millimeter), their pores are so small that the collisions between air molecules that normally account for a large proportion of thermal conduction hardly ever occur inside them. Because their

solid matter is highly ramified, it passes on only a very small amount of this heat. A silica glass aerogel insulates about 200 times more effectively than ordinary glass.

Inventor Kistler concerned himself mainly with aqueous silica glass (siliceous) gels, which he obtained by mixing water glass (a sodium silicate solution) and hydrochloric acid. As water dissolves the gel structure at high temperatures, Kistler replaced it with methanol. He heated this "alcogel" under high pressure to more than 240° C. This turns the gel into a "supercritical" fluid: The particles move freely like gas molecules, removing the tensions at the liquid-air interface. When the alcohol evaporates at these high temperatures and is gradually replaced by air, the form of the gel is therefore retained. The liquid solidifies to a highly porous, light, transparent body, the skeleton of which is formed from highly branched chains of silica glass particles.

Kistler's method took about two weeks to produce aerogel. It is also hazardous, since highly flammable methanol is involved. In the mid 1980's, BASF scientists developed a quicker, cheaper, and safer process: They spray a mixture of water glass and sulphuric acid into a washing solution. The water in the silica glass gel drops thus produced is replaced not by methanol but by carbon dioxide. The drops are then dried "supercritically" at high pressure and at 31° C, forming small spheres a few millimeters in diameter. Although this granulate is rather cloudy, it has the same thermal properties, for much lower manufacturing costs, as aerogel tiles previously used for special applications such as in particle detectors, which detect fast-moving, electrically charged particles.

At Tingen near Freiburg, scientists at the Fraunhofer Institute of Solar Energy Systems have fitted residential buildings with insulation systems made from this granulate using the "transparent thermal insulation" technique. The east-, south-, and west-facing outer walls are painted black and covered with a roughly 50-millimeter thick transparent layer of aerogel. The sunlight penetrates this layer and heats the house wall, which reflects much less thermal radiation than it absorbs. So unlike conventional, opaque insulation materials, aerogels not only prevent heat loss, they also acquire heat directly.

The granulate can also be used as a filler to insulate window panes. However, as with transparent thermal insulation, sealing the material off hermetically poses a technical problem. The Fraunhofer scientists are currently working with BASF to find the best ways to pack the aerogels.

One drawback of transparent aerogels is that the thermal insulation deteriorates as the temperature rises. Above 20° C they allow heat through in the form of infrared radiation; however, this effect only becomes dominant at temperatures above 100° C. Jochen Fricke and his Wuerzburg University colleagues have found a way round this. They add soot particles, which absorb

infrared radiation, to the gel. Although this makes the aerogels less transparent, it makes them better insulators.

BASF now produces such sooted aerogels as granulates. They insulate twice as well as CFHC-expanded materials and can be used without difficulty in heat accumulators or refrigerators. Silica glass aerogels do not burn and are easy to recycle. But for all their advantages, they do have one further drawback: the tiles are more fragile than the finest glass. This makes the 60 by 60 centimeter sheets of aerogel, the size used in particle detectors or as window panes, more difficult to handle.

The organic aerogels that Richard Pekala of the Lawrence Livermore National Laboratory obtained a few years ago from resorcin and melamine, which are relatively elastic plastics, are thus all the more interesting. They are even better insulators than the inorganic materials. Moreover, they can be changed into dark black carbon aerogels by pyrolysis, or heating in the absence of oxygen. They are not only very hard, but are also good electrical conductors, so they can be used in particularly powerful capacitors.

As yet, aerogels are only being used in isolated cases. BASF's pilot plant can produce several hundred cubic meters of aerogel a year. "This gives us a base for bulk aerogel granulate production. Whether we build a larger plant will depend on the extent of demand," says Ruediger Iden.

**Germany: Fifty-kW Solar Power Station Planned**  
*MI1406144593 Munich SUEDDEUTSCHE ZEITUNG  
in German 15/16 May 93 p 21*

[Article by Ulf Brychcy: "The Power Station on the Roof: Solar Energy Could Soon Become Competitive"]

[Text] Great hopes rest on photovoltaics, which converts sunlight directly into electrical current, thus making for ecological power generation. High development and investment costs, however, that hitherto prevented this very recent technology from making a breakthrough. Despite this, there are increasing signs that, at least in major niche markets, solar power could become competitive here in Germany sooner than has only recently been assumed.

The bluish glimmer of solar cells is a familiar sight nowadays. When they are a few square millimeters in size, they provide electrical power for watches and pocket calculators, far more cheaply than batteries. When they measure several square meters, they provide cheap electricity for isolated transmission masts and traffic management systems. In addition, photovoltaic power stations can already be found in locations with high exposure to sunlight: For example, a 280 kilowatt (kW) plant is operating at Neunburg vorm Wald in Upper Palatinate, as is a 340 kW plant at Kobern an der Mosel. However, they are sufficient to supply the electricity requirements for only 70 or 85 homes respectively.

Solar power stations, however, do not make a significant contribution to power generation, with photovoltaics accounting for only 252 megawatts (MW), or 0.009 percent, of the total worldwide generating capacity of 2.76 million MW in 1990. Large-scale plants feeding power into the grid are just too uneconomic, particularly in countries low in sunlight, such as Germany. According to Werner Roth of the Stuttgart Fraunhofer Institute of Solar Energy Systems, generating costs in Germany are at least two German marks [DM] per kilowatt, seven to eight times higher than for conventionally generated electricity.

Solar electricity is, nevertheless, getting cheaper. This was confirmed by a report just presented by Munich generating company Bayernwerk, whose assessment of renewable energies is somewhat conservative: They found that by 2010 the manufacturing costs for solar modules will fall by up to 10 percent, while higher energy output can be expected, improving the efficiency of thin-film tandem cells from the present 6 to 8 percent to 16 to 20 percent.

Bayernwerk director Ludwig Strauss is therefore confident that during the next decade solar electricity costs will fall to less than DM0.70/kW. This fall in price could prove a powerful stimulus to demand for solar cells, thus further reducing production costs—an argument promoted in particular by environmentalist groups, who forecast a price as low as DM0.30 per kilowatt.

In contrast, electricity generated using coal, natural gas and nuclear power will get steadily more expensive, owing to increasing environmental constraints and rising fuel costs: In Roth's words, "the costs will close in." Bayernwerk's report shows that private photovoltaic systems (with three kW output) located, for example, on roofs, will therefore soon become far more economic. In addition, consumers tend to be far more energy-conscious—"Solar power and energy-saving go together," states Roth.

Bayernwerk's priorities are different: The company plans to spend DM1 million on a new photovoltaic plant with an initial 50-kW output in Ismaning, to be initially financed by the sale of shares. The planned minimum investments of "500 watt coupons" for DM6,500 are regarded as "a bargain" by Juergen Leuchtner of the Oeko Institute in Freiburg, who has welcomed the initiative. Capital investors can expect an annual return of only 1.3 percent, however, though this should increase in line with any rise in electricity prices. Strauss, who hopes to attract environment-conscious shareholders, admits that "There is a measure of idealism involved."

Nevertheless, Strauss insists that, unlike for example the solar power station in Nuremberg, for example, the project is intended to be viable without large-scale public subsidies: The company feels that it is worth just being involved. Not only is Bayernwerk the joint owner, with Siemens, of the world's largest solar cell company, but its involvement also enhances Bayernwerk's image.

**Decentralized Plants**

The planned factory does however pose a dilemma: In strict financial terms, major investments in relatively large 300- or 500-kW photovoltaic power stations located in our latitudes make little sense in the medium term. Only if electricity prices increase drastically, or if the technology receives long-term large-scale subsidies, will they become competitive. Furthermore, they are only suitable for niche markets: According to the report, at least 18,000 500 kW photovoltaic power stations would be required to stand in one 1,300 MW nuclear power station. The future of solar power depends far more on small, decentralized solutions, in conjunction with planned energy-saving.

**Germany: Measuring Disintegration of Noxious Air**

93WS0490B Frankfurt/Main FRANKFURTER  
ZEITUNG/BLICK DURCH DIE WIRTSCHAFT  
in German 10 May 93 p 10

[“How Rapidly Do Air Pollutants Breakdown?”]

[Text] JB. FRANKFURT—Professor Dr. Harun Parlar and chemist Ronald Sommerlade of the department of analytical chemistry at the Polytechnical University in Kassel (Heinrich-Plett St. 40, 3500 Kassel) have developed a relatively simple, but precise method of ascertaining the disintegration of air pollutants.

Parlar first notes that pollutants in the atmosphere eventually undergo several complex physical chemical changes. These changes do include the disintegration of the pollutants, but unfortunately they also may recombine into other ecologically harmful compounds.

The OH radical plays an especially important role in the disintegration process. It is responsible for most of the chemical degradation of the pollutants. The disintegration of noxious air is a decisive factor in the potential ecologically harmful effect of a compound. Consequently, it is important to study the ways and rates of disintegration. The Kassel University researchers undertook to build a test system, by means of which the disintegration of organic gaseous compounds by the OH radicals might be simulated.

The testing device consists of a glass reactor that can be irradiated with different kinds of lamps. After the glass reactor has been evacuated, the organic compounds and water are brought to the gaseous phase by means of a septum. Their concentration is determined by means of a Pirani measuring tube. A mass spectrometer is used to measure the change in the parent compounds.

During the tests, a gas mixture consisting of a test substance, an internal standard, nitrogen oxides, and synthetic air is introduced in the reactor and then irradiated with a high-pressure mercury lamp. The OH radicals are created through the photolysis of  $\text{HNO}_2$  nitrous acid, which is formed by the internal reactions in the reactor. After the gas has been introduced, the

compound between the reactor and mass spectrometer is opened to measure the concentration changes.

The decrease in the concentration of the test substance is constantly recorded to permit a determination of the specific disintegration rate of the compound tested. According to Parlar, the advantage of the Kassel system over conventional methods of investigation resides in the fact that there is an online coupling between the test reactor and the analysis system. In addition, the rate of disintegration can be determined relatively quickly and rather inexpensively.

**FRG: Work on Copper-Indium-Disulphide Solar Cells**

93WS0493A Frankfurt/Main FRANKFURTER  
ALLGEMEINE in German 26 May 93 p N1

[“Weight Reduction Program for Solar Cells: Effectiveness of Thin Semiconducting Layers Improved”]

[Text] By using a previously ignored material—copper-indium-disulphide, the Hahn-Meitner Institute of Berlin and Stuttgart University's Institute for Physical Electronics have succeeded in substantially improving the efficiency of solar cells. The efficiency of this material at 7 percent had been way below that achieved through the use of silicon. The 10 percent efficiency value now attained almost reaches the theoretical value. Indeed, the efficiency of solar cells made from large silicon crystals is more than 20 percent. However, depending on the degree of crystal purity, the costs of production can be quite high. On the other hand, the performance that can be achieved through the use of amorphous materials is still not satisfactory.

One solution of this problem is through the use of multicrystalline silicon, a conglomerate of small crystals. In addition, since the mid 1970s, efforts have been made to convert solar energy into current by means of thin semiconducting layers. Among other materials, copper-indium crystals grown with selenium or sulphur, which heavily absorb sunlight, have been found to be suitable for this purpose. Their economic advantage lies in the fact that such layers need only be several micrometers thick.

Both materials, copper-indium-selenide and copper-indium-sulphide, were developed in the U.S. Bell Laboratories. The efficiency of the selenium-treated material is higher, although the theoretical value is significantly lower than the material enriched with sulphur. The theoretical efficiency is derived from the so-called band model. In this model, the discrete, but manifold energy levels of the electrons in a crystal are combined in “quasicontinuous” bands, a valence, and a power band, separated from each other by a “forbidden zone.” Light excitation can cause an electron to jump over this zone into a higher power band in which it is freely mobile and contributes to the electrical conductivity of the crystal.

The right crystal composition can alter the band structure to adapt to the power spectrum of the sunlight. Copper-indium-disulphide is particularly suitable in this regard.

On the other hand, the band structure is extremely sensitive to the smallest deviations from the ideal crystallographic order. In order to approach the theoretical value, the stoichiometric composition—two parts sulphur to one part copper or indium—of the material being produced has to be attained to the one thousandth part. To date, it has not been technically possible to achieve and maintain such precise ratios.

The Hahn-Meitner Institute has therefore changed the production process. In the new process, copper and indium are applied in a sulphur atmosphere by evaporation on glass steamed with molybdenum. As a result, besides the desired phase of copper-indium-disulphide, another phase containing the excesses of copper and sulphur, which can then be etched out, is also present.

Despite the improved process, the efficiency of the thin-layered solar cell is still way below that of multicrystalline silicon and even under that of copper-indium-selenide. However, the theoretical efficiency of almost 30 percent is still tantalizing. Moreover, nothing is as yet known about the stability of copper-indium-sulphide. Hans-Joachim Lewerenz of the Hahn-Meitner Institute is therefore cautiously optimistic about this material. In Lewerenz's opinion, an efficiency of about 15 percent is one of the prerequisites for testing thin-layered solar cells.

**Environmentally-Sound Raw Materials Studied**  
93WS0524A Berlin INGENIEUR DIGEST in German  
Jun 93 p 56-57

[Article by Rolf Wunsch: "Can Agriculture Provide an Alternative?"]

[Text] Flower pots, wine bottle packing, and pressings are a few of the bioproducts obtained from China grass reeds (*Miscanthus sinensis giganteus*). The reed fibers [the reeds are the stalks of the tall grass] already serve as packing material, edge protectors, filling material, etc. Such products today can be used to replace conventional polystyrene. Dr. Johannes Franz is proud of his first ecoproducts: "After they are used, they can be thrown in a compost bin." The business director of Tinox Tierzuch in Nordhausen in Thuringia is in the process of converting his business into the center of German China grass processing.

When that is accomplished, there will be far more than just flower pots and packing. *Miscanthus*, the ecologists believe, may be able to provide many branches of the economy with more ecologically-friendly products. Bio-cemented fiber plates for home construction and even automobile body parts can be produced from reed fiber. VW, for example, is testing whether china reed is suitable raw material for dashboards. Developers at the

Leuna Werke AG are currently working on a pilot plant to obtain hydrogen from certain bioproducts.

The possible applications of Elephant- or China grass, which in just three years grows three meters high and from one to one and a half centimeters thick, seem veritably unlimited. The biomass grows ten times as rapidly as many types of forest woods. With its more than 20 tons of dry mass per hectare, the reeds yield three, often even four times more biomass than the most productive domestic plants.

Dr. Wolfgang Staender, an engineer from Munich, claims to have found 1,745 types of *Miscanthus* in Asia. He believes that the reeds are the cleanest CO<sub>2</sub> energy source. When harvested, which is usually done in the agriculturally slack winter season, *Miscanthus* only has a residue water content of 20 percent. That characteristic alone represents a savings in energy-intensive drying processes.

The calorific value of *Miscanthus* briquettes is about the same as brown coal. Staender estimates that a kilowatt-hour of gas derived from the reeds would cost seven pfennigs, while a kilowatt-hour of energy derived from a nuclear plant costs 16 pfennigs. Dr. Guido Reinhardt, scientific worker at the institute for Energy and Environmental Research [Ifeu] in Heidelberg, is optimistic about the burning of plants as an environmentally-friendly process of generating electrical and heat power, noting that "the biomass is utilized most effectively."

Unfortunately, field tests of the reeds in Germany have not yet provided reliable data on acreage yield, stability, and pest resistance. In the winter of 1991, freezing weather struck the Institute for Agroindustrial Research [Aif] in Brandenburg, where the *Miscanthus* is experimentally grown on 13 different plots (a total of 100 hectares). Since then, the plants have only been permitted to grow outdoors when they are a year old.

Since the grass does not bloom in our climate, and therefore does not produce seeds, the large-berry growers cultivate the plants *in vitro* (cell division in a nutrient solution under glass). Farmers in Brandenburg as well as Mecklenburg-Vorpommern are hoping that the reed grass cultivation will provide a source of income to compensate for acreage taken out of cultivation.

This exotic grass is but one of many possibilities of deriving industrial raw materials from the agricultural sector. Rapeseed oil and flax have already been utilized for some time. But only 2 percent (200,000 hectares) of the acreage in Germany is used for that purpose.

Asbestos-free brake linings, for example, can be made from flax fiber. Germany produces 90 percent of European and 60 percent of the world's brake linings. Another example is biodegradable rapeseed lube oil for chain saws. A study made by the German Federal Ministry for Research and Technology [BMFT] indicates that by the turn of the century 130,000 tons of rape lube oil will be produced and sold.

Despite these optimistic signs, the experts warn against euphoria. It will take at least more 15 years, they say, before even 10 percent of the industrial products that can theoretically be replaced by plant-derived raw materials, will actually be so replaced. The reason for the slow progress is not so much the lack of technical know-how as it is economics. Agricultural products are still simply too expensive for industry to profitably utilize. Rapeseed, for example, only has a chance as an alternative raw material, since its cultivation would have to be subsidized by the government or the European Community. Another BMFT study shows that only about 2 percent of the 23 million tons of diesel fuel used in the Federal Republic yearly can be replaced by biodiesel fuel from rapeseed. One liter of which, without taxes, would cost 2.30 German marks [DM]—four times as much as conventionally produced diesel fuel! Still the Ifeu Institute—in an ecological balance sheet—arrived at positive values for the renewable raw material. Using a method developed by the Ifeu Institute, which is now widely recognized, the Heidelberg researchers—working on contract for the Federal Environmental Affairs Office—have drawn up an energy and CO<sub>2</sub> balance sheet for rapeseed oil and rape methyl ester as compared against diesel fuel. The balance sheet took into account not just the energy values and the CO<sub>2</sub> emissions, which are directly attributable to the burning process, but indirect factors as well.

In the case of rapeseed diesel fuel, the expenses involved in the agricultural processes from the planting to the harvesting, storage, the costs incurred in extracting the rapeseed oil, as well as those in the chemical conversion process are all taken into account. In the case of conventional diesel fuel, the emissions must be considered as are the expenses in the exploration, extraction, and transport of the raw oil, as well as those involved in the refining process and transport to the end user. The CO<sub>2</sub> emissions from rapeseed diesel fuel are at least 35 percent less than those of normal diesel fuel. To arrive at a final evaluation, the amount of other climate-relevant trace gases like N<sub>2</sub>O and methane must also be taken into the balance.

Independent of these results, however, it must be noted that rapeseed diesel fuel, just like plant-derived fats and oils, are not yet competitive for the production of plastics, lacquers, cosmetics, or pharmaceuticals. The Minister for Research and Technology therefore wants the agency for the renewable raw materials. Coordination of research should increase the competitiveness of the plants, especially with regard to product processing, but should also improve the plant cultivation as well.

Genetic engineering, which might be able to "tailor" the plants for industrial use, could play an important role in this matter. Rapeseed types, whose fatty acid chains have precisely the right length, would be one example. Or potatoes, which contain just the type of starch industry wants, is another.

At the present time, however, the reality is far removed from such dreams. Environmental and consumer groups are fighting against experiments in genetic engineering and are warning of as yet unknown, possible risks. In addition, they fear a new, intensive monoculture on German acreage. In view of possible changes in global climatic relations, they warn of the ecological consequences of cultivating, processing, transporting, use, and disposal of biological raw materials. The president of the German Nature Protection Society, Jochen Flasbarth, lists additional factors that may also constitute a threat, namely, erosion, the washing out of nitrates, the vulnerability of monocultures to viruses, and the increased use of chemical plant protection agents. Dr. Hans Meyer zu Dreher of the Berlin Branch of the Federal Ministry for Nutrition, Agriculture, and Forests has an entirely different opinion of the matter.

He points out that there has already been a monoculture in German agriculture for a long time, namely, the cultivation of grain on 70 percent of the acreage. There are other reasons why the fears are not justified. He maintains that the cultivation of energy-source plants would not lead to a monoculture in any case because such production is not even profitable for the farmers.

This could change, however, if the EC Commission can implement its plans to introduce the CO<sub>2</sub> tax on fossil fuels. The International Energy Agency predicts that the price for natural oil could easily and quickly increase to \$30 per barrel. Investigations, in which 16 German scientific institutes and research groups participated, estimates that the use of cellulose-containing biomasses, especially from waste and residual sources, to produce to heat will become competitive when the prices of natural oil reaches \$25 to \$30 a barrel.

The use of China grass and fast-growing trees in complete plant burning processes should become more attractive when the price of natural oil rises to from \$40 to \$50 per barrel. If there are no Government subsidies, the production of rapeseed diesel oil, rape oil methyl ester, and ethanol would only be attractive when the price of natural oil exceeds \$50 per barrel.

These hard figures are just another reason why the plant growers must focus on raising the yield of industrial plants per hectare. The farmers believe that the oil content in rapeseed could be increased from the present 1,500 l/ha to 1,800 l/ha and more. In any case, Meyer zu Dreher believes that this could only be achieved gradually with slow yearly increments of 3-4 percent. Consequently, no one can expect a breakthrough in this century.

The same situation pertains to gas as well. A technical assessment made by the Department for Applied Systems Analysis in the Karlsruhe Nuclear Research Center leaves little room for euphoria: "Even in 15 years its advantages will still cost money."

Consequently, the Federal Ministry of Research and Technology is moving cautiously. It has made almost

DM55 million, the same amount as in 1992, available for the intensification and coordination of research and development of bioproducts in 1993. The professional agency is to help in broadening the possible applications and by investigating the potential of other raw materials like leftover forest woods, straw, animal manure, sludge, etc. The fact that the professional agency is not, as originally planned, part of the Ministry of Ecology but rather has been attached to the Ministry of Agriculture is problematical. Should the department that is concerned with the source of income for the farmers make this decision?

#### **Germany: Potsdam Institute of Climate Research Presented**

*MI1207102293 Bonn TECHNOLOGIE-NACHRICHTEN MANAGEMENT-INFORMATIONEN in German*  
28 May 93 pp 10-11

[Text] The Potsdam Institute of Climate Impact Research (PIK), located in the Albert Einstein Science Park on the Telegrafenberg, was presented to the public on 19 April 1993. The institute was established in January 1992 on the recommendation of the Science Council, as part of the reorientation of research in the new federal laender.

The PIK is unique, not only in Germany but also in Europe. It works on a new scientific field that brings together the natural, economic, and social sciences to focus on major environmental problems. As this field has no scientific precedent, there is a lack of scientists trained in it. Even the organizational and establishment structure cannot be compared with those of other institutes. As a small, flexible, and innovative institute, the PIK is conceived as a think tank designed to work extensively with the entire field of environment research in Germany. It currently has a staff of 38, and an annual budget of around 8 million German marks [DM], half of which is contributed by the BMFT [Federal Ministry of Research and Technology] and half by the Land of Brandenburg.

The PIK's work concentrates on what is probably the most serious environmental problem of our era: the possibility of climate change and its impact on humans and their health, their natural environment, and even their infrastructural systems, such as energy and transport systems. Hitherto there has been hardly any serious scientific evidence on the implications of possible climate changes both for Germany and for other endangered regions of the world. Not only the natural environment, but also economic structures may be affected worldwide by climate change. It is therefore important to know where environmentally caused economic hardship will lead to migration, and the results this will have for Central Europe, the EC, and also for Germany.

Under its scientific terms of reference, the PIK will also provide advice on political and social aspects of global change and its consequences. It is expected to provide sound scientific advice on what steps can be taken in the

future to protect the environment more effectively while at the same time enhancing economic efficiency. Science will show how our society can achieve the structural change necessary to reconcile ecological and economic aspects, the aim being to take Germany into the next century, both as a center of industry and, even more so, as a promising center for environment-compatible technological developments.

#### **France: Large-Scale Diester Fuel Production Program Launched**

*BR2206114093 Paris RECHERCHE TECHNOLOGIE in French May 93 p 10*

[Unattributed article: "Research Program on Non-Food Benefits of Colza"]

[Text] Among biofuels, diester, which is extracted from colza, is both very promising and widely accepted by the oil industry as a partial replacement for diesel oil. The ministers responsible for research, agriculture, and industry and the ADEME [Workshop for the Development of Computer Sciences in Education] are supporting an ambitious research program involving public and privately owned laboratories.

Two conditions are necessary if diester, which is extracted from colza and is a very promising biofuel replacement for diesel oil, is to be a profitable alternative. These include an increase in the yield per acre of colza and finding useful applications for glycerol, a coproduct of diester. Also, to adapt colza oil to new industrial uses, a change in its fatty acid composition is necessary.

#### **Ambitious Program**

This research program, which has an overall budget of 54.7 million French francs [Fr] over four years—including Fr20.17 million in government support—will bring together public laboratories, five companies, as well as oilseed industry organizations such as ONIDOL and SOFIPROTEOL. The public laboratories are the INRA [National Institute for Agronomic Research], the CNRS [National Center for Scientific Research], some universities, and the IFP [French Petrol Institute] (INRA: the plant improvement station in Rennes and biocellular and biomolecular laboratories in Versailles; CNRS/universities: biophysiology and biomolecular laboratory (Pierre and Marie Curie university), physiology and biomolecular plant laboratory (University of Perpignan), Bordeaux cellular biochemistry institute; Toulouse university's agricultural resources chemical laboratory; Compiegne Technical University). (The five companies are Serasem, the seeds production subsidiary of the SIGMA group; Sanofi-Rustica, the seeds production subsidiary of the ELF group; Robbe; Rhone-Poulenc; and IGOL [lubricants manufacturer].)

The program involves the complete production process from plant selection to industrial use. It is therefore a

model project for the agricultural sector. It focuses on the launch of the Robbe industrial unit in Compiegne for the production of 20,000 [metric] tons per year of diester and 2,000 tons of glycerol.

The program has four main objectives:

- To increase productivity and reduce production costs while actively supporting a scientific policy aiming at the development of high-yield hybrid lines;
- Transforming the fatty acid profile of colza to increase the scope of its industrial use (high oleic- and erucic-acid content);
- To identify new uses for glycerol, notably in synthesis chemistry;
- Ultimately to use rapeseed oils in the lubricants sector.

#### **Germany: Centrifugal Plastic Waste Sorting Process Described**

*MI0906140093 Wuerzburg UMWELTMAGAZIN in German No 5, May 93 p 82*

[Text] Germany produces about 2.5 million metric tons of plastics waste a year, 80 percent of which is still dumped or incinerated and only 20 percent reprocessed. The 800,000 tons of plastics, mainly from packagings, that find their way into household waste every year are a particularly great problem. Sorting them is an expensive process and has major disadvantages in that the sorting accuracy is too low, it requires an enormous amount of space, reprocessing takes a long time and plastics reprocessing plants use a lot of water. Recovering plastics by sorting them into distinct categories for making new quality products is virtually impossible with existing technologies.

The new censor (centrifugal sorting) process is the first in the world to use specially constructed centrifuges to separate the various assorted and dirty plastics for subsequent recycling with almost 100 percent accuracy. The centerpiece of the process is a specially developed biconical solid bowl helical conveyor centrifuge. The mixed plastics are fed into the centrifuge in suspension and encounter the surface of a water ring turning at high speed. Here, heavy vortexing takes place. The plastics are isolated for subsequent sorting and most of the dirt removed. In the centrifugal field with its up to 1500 g acceleration, particles denser than water sink to the centrifuge bowl, while lighter particles float to the surface. The two plastics fractions for separation are carried to different ends of the centrifuge by helical conveyors running in opposite directions, their coils having different diameters and pitches, drained in the conical section and removed with about 2 to 5 percent of residual moisture.

A diaphragm extending into the water ring from the helical conveyor prevents floating material being carried away with the sinking material. At the same time the

circulating water is mechanically cleaned in the centrifugal field. If the process is repeated with several centrifuges and working liquids of different densities, different specific plastics can be separated from each other in sequence. Following successful completion of a long-term trial in a largish pilot plant, the process will be put on the market this year.

#### **Germany: Biocontainer Composting Process Described**

*MI2106095493 Wuerzburg UMWELTMAGAZIN in German No 5, May 93 pp 54, 56*

[Article by Gerhard Hanold and Friedel Vollmer: "Composting in Biocontainers—Computer Controls Composting Parameters"]

[Text] The Technical Regulations on Municipal Waste will require the composting of organic waste, probably from mid-1993. About 4 million tonnes/annum of compost could be obtained from 10 million tonnes/annum of organic waste throughout Germany. Composting reduces domestic garbage by a potential 30 to 40 percent. According to the draft provisionally approved by the Upper House in mid-February, old plants will have to meet the requirements listed below within nine years of the Technical Regulations coming into effect.

#### **Composting Requirements**

According to the Technical Regulations on Municipal Waste (Draft), composting must meet the following requirements:

- Biodegradable organic waste must be converted into utilizable compost (soil mulch);
- Compost of a high enough quality to guarantee reliable and sustained sales must be produced;
- Compost production plants must be equipped to prevent environmental damage such as that resulting from infectious bacteria or pollutants;
- The bodies that reprocess suitable organic waste must in all cases have adequate composting capacities;
- The legal requirements differ according to the starting material. Special collection systems are to be set up for organic waste constituted by the compostable component of industrial waste, which is similar to domestic waste, and for market waste. Composting will generally take place elsewhere;
- Waste from public parks and cemeteries, on the other hand, is to be kept separate and utilized on-site if possible, thus requiring no central collection or gathering system. Vegetable waste from roadside gardens and parks are to be sent for composting only if the resulting compost, produced without mixing, satisfies the quality requirements.

The Technical Regulations on Municipal Waste supplement the other regulations governing waste by introducing the statutory separation and composting requirement, thereby initiating a trend toward the aerobic decomposition of organic waste. We describe below a process that complies with the new statutory requirements.

The modular design of biocontainer composting accommodates both adjustments for seasonal fluctuations in organic waste volumes and simple plant capacity extensions. Intensive decomposition in an enclosed system also means that the requirement for an environment-friendly, low-odor process is met.

After separate collection from households, the organic waste is delivered in compaction or drum-type vehicles and unloaded on a flat hopper in the sealed reception and preparation hangar. This building is big enough to take two days' volume of organic waste, plus returns and green waste for improving texture, for temporary storage.

Effluent forming in the hangar is carried away by drains. The air in the hangar is evacuated by overhead ventilators, and can be used as input air for the intensive decomposition process.

After a visual inspection for extraneous matter, the wheel loader loads the comminuter feed hopper with coarsely-textured garden and biowaste. Finely textured material, on the other hand, is placed on the additional charging belt downstream of the comminuter. Scrap is then removed from the organic waste with an overbelt magnet. It is homogenized in a mixing drum and emptied into thermally-insulated, corrosion-treated biocontainers. Their level is monitored automatically.

The containers act as intensive decomposition reactors. They are connected to an air-conditioning ventilation system and to the percolating water drainage system. The organic waste material is evenly aerated on all sides through the container's perforated base so that aerobic conditions and optimum dampness levels prevail throughout.

#### Accurate Dosing of Input Air

The intensive decomposition process takes about 10 to 14 days, and each individual biocontainer can be precisely controlled in each individual phase. An on-line computer regulates the airflow volume in the light of actual/target value comparisons. In addition to actual process control, the memory-programmable control system used is able to store the values measured for each container unit, and to display them on screen or print them when required. In the programmed process, any computer may be accessed at any time, so targeted, application specific amendments may be made to the process parameters according to requirements. Accurate input air dosing starts intensive decomposition, with the characteristic rise in temperature to about 70° C, in a short time. The thermal insulation of the biocontainers

and the recovery of the exhaust air heat make for optimum temperature control, regardless of ambient temperature, and renders thermal sanitization of the organic waste possible in winter.

Malodorous substances occur in the first few days of the intensive decomposition process and are broken down in the biofilters. After a decomposition period of 10 to 14 days, the readily degradable proportion of the organic substance has been mineralized to such an extent that neither appreciable volumes of percolating water nor odors form. The containers are detached and emptied onto a covered secondary decomposition area. Here, the fresh compost is stacked by the wheel loader in piles about 2.5 m high.

After about four weeks, the compost is sieved to 25 mm, and extraneous items, such as plastic films, are removed. The sieved compost matures further for about four weeks before being finely sieved 10-15 mm. After a total of 10 weeks' decomposition, a mature grade IV compost is obtained.

Analysis of compost samples from the Froendenberg plant in the Unna district shows that biocontainer composting meets both the limits specified by the laender working party on waste for composting (M10) and those of the Federal Compost Quality Association and the Blue Angel.

#### Effluent Collected

Effluent is collected, reused, and processed separately according to its organic content:

- Roof water is generally allowed to enter the drainage channel unchanged;
- Rain water may be collected for use in the container washing system;
- Water from roads and yards may be piped to the treatment plant via an open sewage plant reservoir tank;
- Waste water from the reception and treatment hangars may be fed through oil separators and stored temporarily in a closed collecting tank pending treatment.

An odor report dated August 1991 for the composting plant in Unna shows that process control in a closed system with biological deodorization of the exhaust air gives negligible odor emissions.

A joint inspection carried out with the Gelsenkirchen Hygiene Institute and the Ruhr Area Waste Disposal Company revealed that, even at the intensive decomposition stage, the biocontainer composting method provides an epidemiologically safe compost. Enclosure of the post-decomposition stage is superfluous from this point of view.

Specialized firms are ready to market the compost despite the pressure for disposal that is sometimes brought to bear.

### Germany: Pulsating Combustor Recycled as Waste Disposal Unit

*MI1106101793 Wuerzburg UMWELTMAGAZIN in German No 5, May 93 p 118*

[Text] The process is old, but not always celebrated in use. Patented back in 1930, the Schmidt pulse jet, named after its inventor Paul Schmidt, was used in the Second World War as a jet engine for the V1 rocket. Since 1960 the firm SKET in Dessau has been working on a peaceful use of the technology—initially with the aim of using the process to make cement. The results were not particularly good, but it was discovered (still in GDR days) to be suitable for regenerating used foundry sand.

Now a private limited liability company, the Institute has further developed the pulsating reactor, making it suitable for a variety of applications in environmental engineering where a brief intensely hot treatment of dusty to fine-grained materials or the complete combustion of gaseous or liquid substances is required.

#### Wide Range of Uses

Thus, apart from recycling organically bound used foundry sand, the reactor can be used to reprocess siliceous earth. There are other possible applications in thermal excitation processes, crystalline phase excitations and transformations, such as catalyst carrier material manufacture, and transmutation processes like the production of fine-grained iron oxide from iron oxalate. It also has advantages in evaporation and drying processes, such as obtaining highly disperse silicic acid from brines.

The pulsating reactor consists of a combustion chamber and a resonance tube. On the air intake side the combustion chamber has aerodynamic valves to admit combustion air periodically. The closure forms an acoustic resonant chamber on the principle of a pipe open at one end. The incoming fuel-air mixture spontaneously ignites periodically to give approximately constant-volume combustion at the natural frequency of the gas column enclosed in the combustion chamber and the attached resonance tube.

The combustion gases leave the combustion chamber at high speed. This produces a vacuum that draws a fresh fuel-air mixture in at the same time. The compaction causes it to ignite itself explosively. The pressure so produced closes the inlet valve so that the exhaust can escape at high speed only through the resonance tube. The process is repeated at a high frequency. By creating turbulence, the pulsating flow increases the transfer of heat and mass between exhaust and solid more than twofold as compared to a stationary gas flow. The device's high energy density and short dwell times make it interesting for process engineering.

The solid material for thermal treatment is fed directly into the hot waste gas stream at the pulsating combustor. Depending on the material, the temperature may be between 300° C and 1,500° C. The waste gas and the solid pass through the resonance tube in parallel flow and after heat and mass transfer are separated in a collector, e.g. a cyclone. Contact times are in the range of a few milliseconds to two seconds.

Unlike stationary combustion where the fuel energy is only converted into heat, with pulsating combustion it is also converted into mechanical energy. This greatly assists the heat and mass transfer, making it possible to completely split the molecules of combustible substances and combust them to H<sub>2</sub>O and CO<sub>2</sub> with nothing left over. Burn-out is intensified by the pulsation. The resonance tube is thus fully available as a reaction chamber for the thermal treatment of materials.

#### Afterburning Unnecessary

Reaction temperatures around 1200° C mean that no additional afterburning is required. The greater stress on the combustion chamber as compared to other aggregates means that the plant has smaller dimensions. The simple design and robust construction are further advantages.

The manufacturers recommend the pulsation reactor primarily for treating 2 to 1000 kg/h solids. The resonance tube is 100 to 400 mm in diameter, depending on the type and amount of material, and about 6m long.

### Finland: Efficient Paper Pulp Water Purification Process Developed

*BR2906101293 Rijswijk POLYTECHNISCH WEEKBLAD in Dutch 18 Jun 93 p 5*

[Unattributed article: "Chemical Process for Water Purification in the Paper Industry"]

[Excerpts] The Finnish multinational Kemira and the Finnish Pulp and Paper Research Institute have developed a new water purification system especially aimed at the paper industry. Later this year, Kemira will be marketing the system under the name Fennotriox. [passage omitted]

In the foreseeable future, existing purification methods will no longer be sufficient. For this reason, one year ago the Finns launched a research program to find a new waste water purification process specifically aimed at the paper industry.

#### Chemical Process

The new method, developed by Kemira and the Finnish Pulp and Paper Research Institute, is a response to the old, somewhat outdated water purification systems used in the paper industry, according to the Finnish firm. The "Fennotriox process" is a three-stage chemical process, based on the sedimentation of certain components. In order to bring this reaction about, three reagents are

added in a series of three doses. The sludge which is produced is then removed by flotation. The consequence of this chemical treatment is that many of the eutrophication substances disappear from the waste water.

Reports from the multinational say that the process removes 95 percent of the phosphoric components and 85 percent of the nitrogenous substances. The concentration of chlorinous organic compounds also falls by 85 percent, according to the Finns.

The aim is to combine the Fennotriox process with normal aerobic biological purification methods as a sort of after-treatment. Active sludge first eliminates the lion's share of the organic components, after which the chemical process removes the eutrophying substances.

The Kemira research laboratory in Oulu, Finland has since run three trials, which will form the basis for tests using a full-scale system this summer. The aim is to get the system on the market by the end of the year.

	Active Sludge Process	Chemical Process	Total Reduction
Biological oxygen consumption	13.00 mg/l	3.30 mg/l	75%
Chemical oxygen consumption	730.00 mg/l	100.00 mg/l	86%
Chlorous organic compounds	20.10 mg/l	2.50 mg/l	88%
Nitrogen	2.87 mg/l	0.44 mg/l	85%
Phosphor	1.04 mg/l	0.04 mg/l	96%
Color	2180.00 mg/l	40.00 mg/l	98%

## FACTORY AUTOMATION, ROBOTICS

### Offshore Pipes Welded Under Water

93WS0500C Frankfurt/Main FRANKFURTER  
ZEITUNG: BLICK DURCH DIE WIRTSCHAFT  
in German, 19 May 93 p 8

[Article by JB, Frankfurt]

[Text]

### Geesthacht Research Center Develops a New Orbital Welding System

The Geesthacht Research Center has developed a mechanized orbital welding system for underwater applications. The system, called Moss, is particularly suitable for installation and repair of offshore equipment and of submerged pipes. A report by the Geesthacht Research Center GmbH (2054 Max Planck Street, Geesthacht) states that remote control of the Moss by a master computer is possible.

Its report states further that mechanized welding operations are particularly advantageous in not readily accessible places and where the environment does not allow manual welding. A typical application is said to be deep underwater installation and repair work. An added advantage of mechanized welding operations is said to be a steadily maintained high quality of the joints.

As to the Moss, this is a fully mechanized orbital welding system suitable for use underwater at down to 500 m depths and for all methods of gas-shielded welding. It

consists of a three-piece orbital welding head with a chuck, a process-control computer, and a remote control and inspection unit. The remote control, with contact-sensitive display panels and electronic control sticks, is designed to cover up to 1000 m long distances.

One of the welding head components is a two-piece orbital ring, fastened to the pipeline and centered around it by means of tension clamps. Pipes 30-100 cm in diameter can be processed in this way. The orbital ring is made of aluminum resistant to sea water.

The main drive is a 42 V direct-current motor with a speed reducer. A power source and distribution unit has all the output terminals necessary for delivery of the welding current, for energizing the motor, and for producing the gaseous shield. It is also connected to the electronic control circuitry of the process tracking cameras. The cameras should be operative under ambient pressures up to 110 bar.

The system is to be controlled by the master computer at the surface and by the process computer inside a pressure container near the welding site. The process computer commands additionally a quadriaxial position-regulating system. All welding processes can be realized with the aid of a special Geesthacht software.

With shuttle and welding parameters completely matched, the Moss should be usable even for intricate seam configurations and in difficult to handle welding positions. The Research Center informs that the apparatus has so far been successfully tested in many practical experiments, also in making joints at simulated 500 m depth under water and in offshore situations.

## BRITE/EURAM Advanced Machining Project Discussed

93WS0514A Paris L'USINE NOUVELLE TECHNOLOGIES in French 20 May 93 pp 50-54

[Article by Michel Vilnat: "Lathe Work: Lasers and Water Jets to the Rescue"; first paragraph is L'USINE NOUVELLE TECHNOLOGIES introduction]

[Text] To optimize the machining of certain materials that quickly wear down tools, it is helpful to heat the pieces worked with a YAG or CO<sub>2</sub> laser or cool the tools with a high-pressure water jet.

Titanium and nickel alloys and highly alloyed steels are hard to machine using conventional machine tools. Although plated tools have come a long way, productivity is still low and the lifetime of tips short. Specialists are developing aids to make certain machining tasks, notably lathe work, easier. Moreover, a BRITE/EURAM project involving 12 European firms and universities is tackling the problem. The first idea the engineers hit on was relatively simple. "If we can't improve the tool's capacity, let's try reducing the material's characteristics locally." They decided to accomplish this by heating the material past the temperature at which its mechanical performance would decline. "Only lasers can controllably spot-heat the area where the chip is sheared off from the main piece to a high enough temperature. The induction heating systems that Krupp tried long ago are not precise enough," explains Jean-Paul Longuemar, a professor at the Central School, one of the participants in the BRITE BE3366 project.

Although the idea seems a simple one, its implementation is not. Indeed, technicians must heat the material hot enough to "soften" it only in the area where it will be machined. They must avoid melting it, since that would create problems with chip removal. Most important, there must be no thermal impact on the sublayer, for overheating of some heavy-duty steels (such as the 35 NCD 16) causes an overhardening that is just the opposite of what is sought. The optimal temperature for the 35 NCD 16 ranges between 760 and 780° C. Such a narrow range requires a precisely focused beam, which researchers at the Central School generate using a set of mirrors and a 3-kW Cilas 4000 CO<sub>2</sub> laser. The laser emits enough power to heat the material as required during fairly shallow finishing cuts (several tenths of a millimeter). "With good adjustments, we have managed to reduce forces for hardened steel by 60 percent during cutting and 70 percent during penetration. Gains for exotic materials are around 30 percent for now," stresses Professor Longuemar. Another benefit of using lasers is their effect on surface condition. "In some cases, surface roughness drops by half," the professor says.

Laser assistance is not limited to the finishing stage. The Central Weapons Technical Establishment (ETCA), which manages the scientific aspects of the BRITE program, is working on tasks involving roughs. The Arcueil specialists have a high-power, 22-kW CO<sub>2</sub> laser

that gives them a great deal of energy to work with. Three other materials besides 35 NCD 16 steel were selected for the study. They include the TA 6 V titanium alloy, Inconel 718, and a ceramic, silicon nitride. ETCA engineers are currently primarily interested in titanium, which is always difficult to work using conventional methods. Their initial results show an approximately 25-percent reduction in cutting force. The Arcueil facility is conducting milling-assistance tests using the same technique. Because the surface areas worked are larger, however, the laser must be more powerful. Whether for milling or lathe work, matching laser to material is not always easy. Some metals tend to reflect much of the laser's light. To overcome this, technicians run the pieces through black carbon, which causes them to absorb 90 percent of the energy. The same trick is already used industrially for laser surface treatments.

Some of the participants in the BRITE program, such as IREPA in Strasbourg and FIPT in Aix-la-Chapelle, are exploring another option. IREPA specialists knew that improving the match between material and beam required shortening the laser's wavelength. So they opted for a YAG (1.6 μm) instead of a CO<sub>2</sub> (10.6 μm). They are conducting research with a 1-kW BMI pulsed laser that can deliver 50 kW at peak power. Another advantage of the YAG is that its beam can be carried by an optical fiber. Since the peak powers involved (10 to 20 kW) are too high, IREPA had to resort to a set of mirrors. This is a handicap since nearly 40 percent of the power is lost. Furthermore, the beam cannot be focused at the point closest to the piece. But, as Jean-Paul Gaufillet says, "the use of new optical fibers that can tolerate 30 peak kW will enable us to direct the beam to exactly where we want, and will restore the YAG's value." Moreover, the new, more powerful (up to 3 kW) generation of pulsed YAGs will provide more energy at a higher frequency.

### The YAG's Excellent Performance on Ceramic Pieces

"The first tests on steels using the mirror setup were not very good. We estimate we reduced force by only 10 percent," explain engineers at IREPA. Such a small gain is obviously not profitable industrially. In contrast, engineers at FIPT, a German technical center, achieved excellent results with ceramic pieces. Ceramics, such as silicon nitride, absorb laser radiation well, so well that the laser's power must be subjugated to the rise in temperature. Indeed, a deviation of +/- 50° C would be fatal to the material, especially since the interaction between the laser and the material only lasts a few milliseconds. "Our results are very promising. It is becoming feasible to turn ceramics on a lathe using tools made of cubic crystalline boron nitride (CBN) or polycrystalline diamond instead of machining them by grinding," stresses Jean-Paul Gaufillet.

Researchers are now working on modeling beam/material and tool/piece interactions, and on viscoplastic phenomena. PSA has put together a database that collates all the findings of the program's various partners. Although ceramics will probably be the first materials to

benefit from laser assistance, industrialization still raises problems. Laser beams must not damage machines or injure personnel (a chip in the wrong place can divert the beam). Moreover, a segment of the BRITE program deals with personnel and machine safety.

Laser heating is not the only way to facilitate machining. ENSAM, in Paris, is looking at a very-high-pressure water-jet technique. Initial tests were run using pure water forced at 3,800 bars. The results are interesting: Water cools the cutting edge, promotes fragmentation of the chip, and creates a sort of externally pressurized porous bearing between the tool and chip (friction decreases), thus reducing cutting force and wear of the tool.

#### Water Jets Double the Life of Tools

Initial tests required 4 to 5 liters of water a minute under 3,800 bars of pressure, and used a jet about 1 mm in diameter. "The first thing we had to do was find a good orientation for the water jet." Engineers looked at two ways the water could be injected: on the cutting side, or on the side of the lead angle to work. The first option seems to work best for now. "This aid enables us to at least double the life of the tool (in some cases increasing it by a factor of 10) or to boost productivity," maintains Alain Cornier, head of production, research, and development at ENSAM.

Depending on the application, some manufacturers, such as those in the aeronautics industry, will prefer to increase the material flow rate. In contrast, the auto industry is looking to improve the quality of machined pieces and the fragmentation of chips. Consequently, initial tests were conducted on Inconel type cast iron, steels, and alloys, which are commonly employed in both industries. Although technicians performed the first trials using carbide tips, the use of ceramic ones is entirely possible. "However, it is the shape and flow rate of the liquid that seem to be crucial, more so than the pressure. We are preparing a new round of tests employing pressure of around 800 bars. The basic parameter is the cooling of the tool's cutting edge," stresses Alain Cornier. Indeed, the more poorly the machined materials conduct heat, the better the results.

New single-stage pumps will reduce pressure but easily speed up the flow rate tenfold. Single-stage architecture makes it possible to use water to which soluble oil has been added, which cannot presently be done with very-high-pressure systems. For now, engineers resort to an extra lubrication to prevent corrosion. If initial results are confirmed, this method of facilitating machining may be developed further. For at this pressure level, pumps cost only half as much as a 3,000-bar system. In addition, reducing pressure will lessen noise, an important factor in industrialization. Last but not least, the price of a water-jet system (a high-pressure pump costs a little over 500,000 French francs [Fr]) is less than that of a laser.

The Japanese have pushed this approach, which entails boosting the flow rate and reducing pressure, much farther still. At the IMTS exhibition held in Chicago in

September, they displayed for the first time ever machining centers with water jets. Mitsui Seiki exhibited its High-Jet, a numerically-controlled pressurized sprinkling device that would triple the life of a standard tool used for deep machining of hard steels. Working pressure is limited to 69 bars, but the flow rate exceeds 60 l/min. Saeilo Machinery displayed its Flojet, a sprinkling device for lathe work that mixes cutting fluid with a CO<sub>2</sub>-cooled liquid.

The third method for facilitating machining consists of mounting the tool on a sonotrode. The latter vibrates the tip ultrasonically during cutting. Since matter is never perfectly homogenous on a microscopic scale (some areas show dislocations), the ultrasound waves would make it possible to jump from one dislocation to another. This would reduce cutting force, increase the material flow rate, and improve the condition of the surface, which would show fewer lamination defects. What is more, Rt surface roughness would drop 30 percent. ENSAM specialists will soon begin a complete round of tests on different materials to assess the technique. For not only is it cheap, it could be combined with laser or water-jet assistance—still unexplored territories.

#### Boxed Material: Using Abrasive Water Jets in Lathe Work

Abrasive water jets are generally used for cutting work, but they can also replace cutting tools in lathe work. Alain Cornier, the head of ENSAM's production, research, and development department, enumerates the technique's advantages and drawbacks. "No matter what material is being worked, the material flow rate does not vary much. Initial results come in at about 3 to 4 cubic cm/min. However, the surface roughness obtained is fairly mediocre—about 8 to 9  $\mu\text{m}$  Ra. We have high hopes of improving it, however. Working speed could easily be boosted as long as the depth of cut is reduced. Productivity would be identical but surface condition would improve sharply. Moreover, a better matchup between abrasives (nature and size of grains) and the material to be worked would produce better results."

## LASERS, SENSORS, OPTICS

#### Friction Force Microscope Developed in Basel, Tokyo

93WS0490A Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT  
in German 10 May 93 p 10

[“Friction Force Measured under a Microscope”]

[Text] oel. FRANKFURT—A further development of the scanning tunnel electron microscope and the atomic force microscope is now capable of detecting the frictional force occurring between atoms and molecules. The instrument is called the “friction force microscope,” or the FFM for short. It will primarily be used to investigate

stress and friction forces that occur in the surface layers of materials among various atoms and molecules.

The development was announced almost simultaneously by researchers at Basel University's Physics Institute and at Tokyo University. These extremely minute forces serve to represent the surface layers of a material and polymer mixture and ultimately to distinguish the individual groups of atoms or larger molecules from each other.

Atomic force microscopes [AFM] had not before been able to distinguish these differences because they could only see the bonding between atoms. But for very many material investigations it is precisely the differentiation of the atoms, of their arrangement, and of the forces between them that is more important than the force of chemical bonding between them.

The new microscope does not have as high a resolution as the AFM. It reaches about five angstroms, which however is about the force range in which most of the stresses between atom groups occur. Meanwhile the first observations have also been made of organic compounds like polymers.

The fluorinated areals showed many times higher stress than did the hydrogenated areals. This behavior had not been able to be explained previously because fluorinated organic compounds like teflon, for example, showed extremely good anti-friction properties.

The investigations were made on layers consisting of few molecules with so-called Langmuir-Blodgett films set on a quartz base. Depending on the fineness of the film, several perforations existed. Thus, the stress forces of the quartz surface could also be measured. They were found, on average, to be 10 times higher than those in hydrocarbon areals.

Nor is this behavior as yet fully understood. Both groups of researchers made it clear that they had only just begun their measurements and studies. They are optimistic about gaining important insights concerning the mechanical and physical behavior of surface layers and possible technical applications to lessen the surface friction forces of both organic and inorganic materials.

### Holography Used for Detecting Interference Patterns

93WS0500B Frankfurt/Main FRANKFURTER ZEITUNG: BLICK DURCH DIE WIRTSCHAFT in German, 19 May 93 p 8

[Article by P.W., Aachen]

[Text]

### Interference Patterns Indicate Noise Sources: Aachen Scientists Use Holography in Search of Vibration Causes

Troublesome vibrations of automobile body parts can be located with the aid of holographic interferometry. A procedure for this purpose has now been developed

jointly by the Fraunhofer Institutes of Production Technology and Laser Engineering in Aachen, the Machine Tool Laboratory at RWTH in Aachen, and Parsytec Industrial Systems GmbH in Aachen. In automobiles moving at high speeds such vibrations can become irritating and make the ride uncomfortable. As a rule, vibrations of the body sheet metal occur at specific places. These places must be located and the vibrations there damped by structural design.

Similar problems can arise in machine tools. In order not to exceed the manufacturing tolerances, it is necessary to optimize the structural design of the given machine tool so that its deformations during machining operations will remain within narrow limits. A computer-aided determination of deformations by the simulation method is, however, sufficiently accurate for simple structures only.

More intricate objects must be checked out on prototypes. With the aid of holographic interferometry, should it now be possible to accurately determine the total deformation of a structural part during some time interval with a resolution of less than one micrometer. For this the test object in its initial and final state should be illuminated with a laser beam at both the beginning and the end of that time interval respectively, whereupon the reflected light will be holographically recorded. The hologram should contain information about the structural deformation along one space coordinate.

Determining the deformation along only one space coordinate is, however, not sufficient for optimizing intricate structures such as machine tools and automobile bodies. In order to establish the feasibility of also accurately determining their deformations, this holographic technique is being tested in a joint project with the automobile industry.

A continuous-in-time display of any intermediate states should indicate the three-dimensional deformation of a structural part during one vibration cycle, as in the case of motor vehicles moving at high speeds. It is reported that three-dimensional deformations of a complete structural component can, by means of recorded interferograms, be thus determined and displayed within a few minutes.

Images are in this project evaluated with the aid of a Parsytec computer of the Multicuster-2 series, using 12 processors. Use of the Utopia image processing software and a Transputer Image Processing system (Tip-bussystem) should further enhance the capability of holographic interferometry for future applications.

### MICROELECTRONICS

#### United Kingdom: Machine To Repair Defective Multilayer Circuits

BR2105151693 Paris ELECTRONIQUE INTERNATIONAL HEBDO in French 6 May 93 p 29

[Article signed L.M.: "Metallized Holes in Multilayer Circuits Now Repairable"; first paragraph is ELECTRONIQUE INTERNATIONAL HEBDO introduction]

[Text] Thanks to a metallization bath-dispensing nozzle, defective contact holes in plated-through multilayer circuits can now be remetallized, making it possible to salvage circuits that used to have to be discarded.

The PTH [plated-through hole] machine of Welsh manufacturer EES performs the veritable feat of salvaging multilayer circuits which previously had to be discarded because of defective plated-through holes (uneven metallization, for example) that no device could fix. This piece of equipment which replaces defective holes uses a dispenser nozzle which locally applies the very same metallization bath used during the initial electroplating process.

The plating technology is also based on electrolysis in order to ensure the same metallization quality. More than a repair, this is a process which actually "reconstructs" the damaged hole: Before plating, the hole must be drilled again with a slightly larger diameter than that of original hole. The nozzle then applies degreasing and cleaning solutions in six preliminary stages which last about 10 minutes and require the assistance of an operator. Copper deposition can then begin; plating thickness depends on the duration of the electroplating process: It usually takes 30 minutes to achieve a "standard," 25-micron plating; this second phase requires no operator.

#### Machine Pays for Itself by Salvaging One Single Board

According to Claude Halbronn of Tecmo (the distributor of the PTH machine for France), single-layer circuits are easily repairable using eyelets, but this has not been the case for multilayer circuits. "To find during testing that a circuit that may be worth up to 100,000 French francs [Fr] must be discarded for lack of a way to repair it is a real disaster; in such a case, since it costs about Fr30,000, the PTH machine pays for itself as soon as the first board has been salvaged," he added.

#### France: LAAS Lab Specializes in Microsystems, Microwave Devices

*BR0706132793 Paris ELECTRONIQUE  
INTERNATIONAL HEBDO in French 13 May 93 p 16*

[Article by Marina Angel: "Toulouse-Based LAAS Lab Bursting With Microelectronics Projects"]

[Text] Following the launch of the MCCT, the Microtechnology Cooperative Center, Toulouse, the LAAS [Laboratory for Automation and Systems Analysis] in Toulouse is preparing for the opening of a center for the characterization of ultra-high frequency components.

The LAAS in Toulouse is celebrating its 25th anniversary this month—the ideal occasion for its director, Alain Costes, to take stock and to look ahead to the future of his laboratory, which is heavily biased toward microelectronics. (LAAS employs 400 people (including 150 researchers and 150 doctoral students), issues 600 publications per year, and boasts 35 agreements with

laboratories in 14 different countries and 119 research contracts with manufacturers.)

LAAS opened on 10 July 1967, under the auspices of the CNRS [French National Center for Scientific Research]. Research and development at the center focuses on five main fields: automation, information technology, microelectronics, industrial automation, and robotics. "Today, LAAS is the largest CNRS laboratory in France," says Alain Costes, "and we are going to expand further." An additional 2000 square meters are planned for delivery in 1994 to boost this expansion.

In terms of microelectronics, LAAS's commitment to play an active part in developing a microtechnology research center in Toulouse, the MCCT (see box), coincides with a study into setting up a Regional Microwave Instrumentation and Measuring Center (CRIMMO). This project is less complex than the MCCT and is currently the subject of a feasibility study. If it succeeds, the CRIMMO will combine the resources for characterizing and measuring ultra-high frequency components. This center would be housed within LAAS and would, via agreements, cooperate with all the manufacturers and research laboratories concerned, including the CNES [National Center for Space Studies], UPS, Alcatel Espace, and regional small- and medium-sized industries such as Sodielec and the Societe Electronique Occitane.

As far as information technology is concerned, two main trends can be identified. First, activities based on operational reliability and fault tolerance. In recent years, these activities have stressed the fact that accidental system-inherent faults (breakdowns) have to be taken into account, while the new trend is to apply the same methodology to considering the security aspects linked to intrusion. The work carried out by the "communication tools and software" group could enable LAAS (and Toulouse) to be selected in the near future as one of the three locations in France for experimentation into a large-scale multimedia development program.

Finally, the laboratory in Toulouse is closely involved in CNRS negotiations on setting up a laboratory in Japan to combine French and Japanese know-how. Although it is still too early to describe this project in detail, it has already been established that microtechnologies, and Microsystems in particular, will be at the heart of the work carried out at this planned research laboratory.

#### [Box]

#### Microsystems: MCCT Aims For 30 Manufacturing Partners

Last January, the MCCT (Microtechnology Cooperative Center Toulouse), the specialist microsystems research center, got off the ground with the launch of its first six projects. "By 1995, the MCCT, which will operate on a project-by-project basis, will be able to handle 20 to 30 projects, in other words 60 full-time employees," envisages Daniel Esteve, deputy director of LAAS, the driving force behind the MCCT. The MCCT's initial activities

are being temporarily accommodated within LAAS, while it awaits the delivery of technical buildings and a clean room on the same site in 1994, at a total cost of some 14 million French francs [Fr]. By 1997, a total of around Fr109 million will have been invested in the MCCT, which will essentially be a resource center. Of this amount, Fr36 million will be earmarked for materials (the development and growth of layers); Fr16 million for lithography and micromachining; Fr14 million for the characterization, modeling, and CAD [computer-aided design] of microsystems; and Fr22 million for three-dimensional bonding technologies. In terms of basic research, the MCCT's activities will be based primarily on developing CAD for future microsystems. The applied research projects, or "industrial projects," will possibly include the pilot production stage. Additional manufacturers should soon be joining the MCCT alongside the three cofounding companies, Thomson-DOI (Computer Tools Division), CITA, and ACTIA.

Contacts have been established with Toulouse-based companies such as Alcatel Espace, Matra Marconi Space, Siemens Automotive, and Motorola. "However," they say at the MCCT, "our ambitions are national and European. In the long term, we are hoping for around 30 partnerships with manufacturers."

**UK: Inmos T9000 Transputer Presented**  
*MI0807151993 Turin MEDIA DUEMILA in Italian*  
 May 93 pp 56-57

[Article by Carmen Carlucci: "155 Million Words per Second"]

[Text] London—The T9000, the lastest of the transputer family, officially saw the light three years after the start of its design when Inmos, the British company of the SGS-Thomson group, presented it to Europe's press within the beautiful setting of the Victoria and Albert Museum.

The T9000 is a unique "newborn," the most rapid monolithic computer in the world, a chip smaller than a fingernail with 3.3 million transistors. As opposed to ordinary microprocessors, a single T9000 transputer contains both communication channels and storage making it a real self-sufficient computer. To appreciate the T9000's velocity and power one need only point out that each of the four communication channels can transmit, in one second, all the information contained in at least 20 Bibles, i.e. about 155 million words per second.

Another characteristic of the Inmos T9000 in addition to its velocity is its ability to connect several components operating as a "team." Specific integrated communication channels allow several transputers to communicate with each other without interrupting their work; a network of hundreds of T9000's can work "as a group" thereby allowing problems to be solved much more quickly than when using traditional solutions.

The potential field of application of this latest transputer is extremely wide, ranging from telecommunications to military electronics, image processing, optical character recognition, to network communications systems and supercomputers.

In technical terms the T9000's velocity can reach 200 Mips [Millions of Instructions Per Second] and 25 Mflops [millions of floating point operations per second]; the device measures less than 10x20 mm and incorporates a 32-bit super-scalar integer processor, a 64-bit unit for floating point operations, a virtual channel processor, 100-Mbit/s communication channels and a 16-Kbyte memory.

How does a transputer work? In practice, like a human brain which processes information in parallel and carries out several functions at the same time. As opposed to ordinary microcomputers, transputers do not execute one function at a time but subdivide a problem into its basic components, process them at the same time whilst communicating with each other to guarantee the correct operation of the system.

In the mid eighties, transputers marked a real revolution leading to parallel systems and multiprocessing. Improvements gradually took place and they proved suitable for the embedded control system and high performance data processing system markets. Today, more than 5,000 users resort to the transputer family for more than 2,000 applications currently under production, being designed or appraised.

Special interface chips will ensure the T9000's compatibility with previous systems. Its communication channels operate at 100 Mbit/s and provide a 20 Mbyte/s two-directional communication frequency. A virtual channel processor consists of two virtual channels carrying messages of arbitrary length and subdivided into packets having a maximum length of 32 bytes. As with normal data transmission, the various message packets are interspersed in a single channel. A special interconnecting chip transmits messages to their intended destination and an integrated conversion unit will allow the T9000 communication channels to be connected to serial channels.

The T9000 is the basic product of a new family. Variations for specific applications will be developed at a later stage but its compatibility in terms of operating instructions and communication procedures will remain the same.

Inmos's future activities, which have already started, include the Chameleon program whose goal is the production of innovative microprocessors from the mid nineties to the beginning of the next century.

The Chameleon program aims at developing a series of low-cost modules capable of supporting large volume applications with an extremely high level of integration i.e. more than 10 million transistors. The Chameleon program will develop general modules complying with

standard interconnection protocols. Dedicated modules are also planned such as an ATM [asynchronous transfer mode] communication processor and a video and graphic processor.

Products developed within the framework of the program are intended for large volume markets such as the telecommunications market (a sector in which current transputers have already established themselves), equipment and terminals such as multimedial and portable work stations, and data base servers. Chameleon will provide products of varying computing and communication levels to support these applications and will allow the incorporation of dedicated processing or communication functions.

#### **University Work on MIM Flat-Panel Displays Discussed**

*93WS0511A Stuttgart BILD DER WISSENSCHAFT in German, Jun 93 pp 18-22*

[Article by Roland Bischoff, free-lance science reporter]

[Text]

#### **Stuttgart Scientists Challenge Japanese Manufacturers of Flat Displays**

The flat displays that come with all laptop computers were never light-intense enough. Professor Ernst Lueder and his team at the Stuttgart University have changed that. Utilizing their MIM-technology, they have made flat monitor displays twice as bright.

Who may watch a film with Asterix and Obelix during working hours without enraging the boss? In Stuttgart such a lucky situation is enjoyed not only by movie house employees but also by staff of the display engineering laboratory. To the scientists under Prof Ernst Lueder of the Institute of Network and System Theory at the Stuttgart University, however, this colorful animated cartoon signifies hard work.

The research team has committed itself to development of novel displays. For testing these displays, the valiant Gauls have been engaged as a sort of honorary co-workers. Lueder and his associates are developing displays which not only will revolutionize home movie viewing of the future but also should serve as a guide to motorists. At the same time, these Stuttgart researchers want to defy the Japanese competition and the chances of success are pretty good.

Until now the Japanese have dominated the market for flat liquid-crystal (LC) displays, a "flat man" from the Far East being found in almost every laptop computer (see "The Magic Dwarf" in *BILD DER WISSENSCHAFT*, No 10, 1991). Unlike displays of computer monitors and television sets with cathode-ray tubes, these LC-displays have two drawbacks: they are

extremely dim and quite small. Large displays, with a 50 cm or longer diagonal, cannot be produced by conventional technology.

"We set out to make a new development emerge from our laboratory. Our display shows pictures twice as bright as those on conventional flat displays. It can therefore be also viewed in full daylight" says Ernst Lueder as he praises the work of his team. For obtaining displays even as large as of the canvas screen format, the Stuttgart scientists resort to a simple artifice: forming the picture on a small display and then projecting it by means of mirrors and lenses onto a large fluorescent screen.

"This procedure is, in principle, similar to slide projection," illustrates Lueder. Instead of the slide, however, a  $10 \times 8 \text{ cm}^2$  mini-display acting as a light valve is included in the optical system. The picture is not projected across the room but, instead, enlarged within the apparatus and then projected onto a  $1.5 \times 1.2 \text{ m}^2$  fluorescent screen.

This back-projection principle is not newsworthy. The novelty is how the Stuttgart scientists drive the  $1.2 \text{ million pixels}$  of their  $80 \text{ cm}^2$  mini-display. They do it by replacing the conventional thin-film transistors used in existing liquid-crystal displays with MIM (metal-insulator-metal) elements.

The light valve consists basically of two very thin glass plates only  $0.0035 \text{ mm}$  apart and between them a cholesteric nematic liquid crystal: a special fluid substance which, depending on its electrical state, either passes light or stops it.

Strictly speaking, the liquid crystal is responsible only for passing light and the role of stopping it is taken over by the two glass plates. On each of the latter is at some time deposited a polarizer which allows the light to pass in one plane only. The two planes of polarization cross at right angles so that passage of the light is completely prevented. The polarizer on the first glass plate passes only light waves propagating in one exactly vertical plane. The polarizer on the second glass plate then passes only light waves propagating in one horizontal plane. When the two polarizers are switched on one behind the other, then no light can pass at all and the second glass plate appears dark.

This is where liquid crystals come into play. Their molecules, oriented in groups, have the ability to transmit light while rotating its plane of polarization through a  $90^\circ$  or  $270^\circ$  angle. That plane of light waves thus is, after passage through the vertical first polarizer, rotated so as to ensure their passage also through the horizontal second polarizer and to make the the second glass plate appear bright. A small potential difference of a few volts applied across the liquid crystal will change the orientation of its molecules in such a way as to make them rotate the plane of polarization of white light and thus cause the second glass plate to become dark again. This is the underlying principle of liquid-crystal indication. By subdividing each glass plates into an array of

separate fields, one can produce various bright-and-dark patterns depending on the voltage across each corresponding plate segment. Each field then represents one pixel (picture element). The more such fields there are, the more differentiated can the patterns be.

#### Liquid-Crystal Displays for Future Television

Chromaticity is obtained by covering one of those very thin glass plates with a grating-like raster of red, green, and blue dots. In the novel display invented by the Stuttgart research team the size of each of the 1.2 million pixels is  $0.080 \times 0.080 \text{ mm}^2$  so that there are 15,000 pixels per square centimeter.

In conventional flat displays individual pixels are each switched on and off by a thin-film transistor (TFT) mounted on it. In the novel ones MIM-devices rather than such transistors control the pixels and make sure that the light either can or cannot pass.

"An MIM-device," explains Ernst Lueder, "is constructed like capacitors and so has only two electric contacts." Therein lies its advantage over a TFT with necessarily three contacts, namely 1.2 million fewer contacts and thus a simpler wiring pattern which also lets more light pass through.

An MIM-device occupies only 0.5 percent of the pixel area and this, too, contributes to a bright picture. "MIM-addressing produces an 80 percent aperture (measure of picture brightness) under the dash of any one pixel, while TFT-addressing produces only a 42 percent aperture," says Lueder. In terms of the decoded text, this means that MIM-displays are about twice as bright as TFT-displays and, therefore, admit use of light-intense screens.

This has been confirmed by Werner Fertig of the Optrex Europe in Babenhausen near Frankfurt am Main, one of the leading European manufacturers of LC-displays: "Not only larger apertures but also advantages in the production process are likely to be realized by MIM-addressing, inasmuch as the fabrication of such a display requires fewer steps." The principles of MIM-technology were years ago conceived at the Bell Laboratories in America. "Neither the U.S. nor Japan, however, have managed to cure these electronic midgets of their childhood diseases," reports Lueder. "One of our team members got hold of the idea and developed it further."

This breakthrough notwithstanding, MIM-devices have one drawback: with these devices it is possible to realize only 128 shades of gray and, therefore, not possible to attain the high picture quality of TFT-displays. For most applications, however, 128 shades of gray are entirely sufficient.

#### Luminous Kernels - How Liquid-Crystal Displays Function

Characteristic of LC-displays are their efficient space utilization and small weight. The Stuttgart research team

is working on the so-called MIM-technology: MIM-LC displays are clearly more light-intense than existing Japanese TFT-LC displays. Pictures are transferred to the luminous screen surface by a projecting system, as they are by slide projector. Instead of the slide, however, the optics include an LC-display of the  $8 \times 10 \text{ cm}^2$  size with 15,000 pixels per  $1 \text{ cm}^2$ . Whether or not a pixel lights up is determined by the orientation of the liquid crystals. When electric current flows through them, then the crystals orient themselves parallel to one another and prevent the passage of light beyond the polarization filter. In the absence of an electric current the crystals twist relative to one another and let light pass to the projector plate. A particular advantage of the MIM-technology is that the control device mounted on each pixel is substantially smaller than a conventional TFT and thus absorbs less light. An MIM-controlled pixel is consequently twice as bright as a TFT-controlled one.

Despite the dominance of Japan, which produces 90 percent of all LC-displays on the world market, Professor Lueder thus envisions an excellent chance that the technology his Institute has developed will succeed on this market.

The fabrication of an MIM-display requires a clean work place. Just as in production of chips on a silicon wafer, the pixels and their switching components are deposited layer-on-layer on a glass plate and then contoured by a masking-and-etching technique. The difference is that while a silicon wafer is afterwards sawed into chips and the defective ones then readily removed, the glass plate for a flat display must obviously remain intact. The entire glass plate becomes unusable when the number of faulty pixels on it is excessive. This is why large LC-displays are not yet available. "We have nevertheless already built a 20-inch (diagonal) size laboratory prototype," reports Lueder. This, however, is not the end of the road.

For fabrication of their displays the Stuttgart research has acquired a class-10 clean space with an almost  $500 \text{ m}^2$  floor area. In this eminently adequate dust-free room there are less than 300 particulates of the  $0.5 \mu\text{m}$  size fraction per cubic meter. The room is, moreover, so well vibration-proofed that the displacement amplitudes within the 3-7 Hz frequency band are smaller than  $0.5 \mu\text{m}$ .

Such a highly advanced laboratory technology is obviously costly. The laboratory opened in April 1991 on the Stuttgart Pfaffenwald campus cost almost DM35 million: 74 percent of the funds provided by the Federal Ministry of Research and Technology, the remaining 26 percent provided by the State of Baden-Wuerttemberg. So far the new "flat men" from Pfaffenwald are not yet for sale. This could, however, change in the foreseeable future. The light-intense technology can be applied first of all to HDTV (High-Definition Television). Instead of the customary 150,000 pixels, these displays of future television sets will have 800,000 pixels per color and will thus show a substantially sharper picture. Should the

HDTV-technology ever advance further, this may lead to an upheaval similar to the changeover from black-and-white to color television.

Lueder is confident that "when HDTV comes, it will come only in this version." The artifice of indirect projection onto the fluorescent screen makes it feasible to enlarge a picture of the  $80 \times 10 \text{ cm}^2$  size to 15 or even 20 times the size. As of now the television optics remain boxed inside large sets. If better fabrication techniques will make it possible to build larger flat displays, however, there will be no need for reversing optics. Then, say the Stuttgart scientists, one will be able to construct an LC-display which is only 4 cm deep and can be hanged on the wall like a painting.

The advantages of LC-displays over cathode-ray tubes include, in addition to smaller volume and weight, lower energy consumption and a low operating voltage: 20 V instead of at least 2000 V. They are also flicker-free and do not emit radiation. Their one disadvantage, common to all LC-displays, is that they are not as bright and light-intense as cathode-ray tubes. This may be the reason why the great "flat men" breakthrough has so far not been realized.

One may, therefore, be anxious about how the light-intense laboratory MIM-displays will assert themselves in production. Besides their use as for television screens with back-projection, they may apparently found to be suitable for direct viewing. Vehicle manufacturers, for instance, are greatly interested in this.

Especially in an automobile, which operates under variable lighting levels, are needed light-intense displays which can still be read when the sun shines on the dashboard. With the existing LC-displays this is only conditionally possible and German automobile manufacturers are, therefore, greatly interested in MIM-displays.

A consortium has already been formed within which the electronic giant Philips and the German automobile manufacturers are jointly working on an MIM-display twice the size of a car radio. Built into the dashboard, it is to provide the driver with traffic information. Under consideration is here a so-called navigation systems, a sort of electronic land map.

The participants in this projects ar not revealing its exact status. "The matter is not yet ready for public announcements," say the people at the Wolfsburg Volkswagen Works who have taken over the bookkeeping activity for the group.

The response from Mercedes Benz is more open about it. The Stuttgart automobile manufacturers are developing displays for motor vehicles, at this time liquid-crystal color displays with TFT control. "A changeover to MIM-technology is being worked on, the object being to raise the productivity and thus reduce the costs," confirmed the management in response to an inquiry.

It is not possible, however, to predict when the first automobile MIM-LC display will actually appear on the market. Philips, the only European manufacturer of LC-displays with active TFT control will "in about the middle of this year" announce its new plans for flat displays.

Other than that, however, the Dutch firm holds politely back. "For various reasons," say the people at its Philips Car Stereo subsidiary in Wetzlar, "we would like to withhold any comment at this time."

### Swiss Develop Chip To Simulate Biologic Behavior

93WS0520B Geneva JOURNAL DE GENEVE  
in French 5/6 Jun 93 p 25

[Article by Nicolas Henchoz: "A Chip that Behaves Biologically"]

[Text] The EPFL (Lausanne Federal Polytechnical School) and the Swiss Electronics and Microtechnics Center have just patented a new concept of artificial life: a microprocessor that develops like a biological creature. "I want to throw myself into this heart and soul. It is truly basic research. I don't know where it might lead us, but I hope that by next year all my colleagues will be working on the project. To my knowledge, no one has yet developed such a concept." In Brussels, Daniel Mange, a professor at the EPFL's Information Science Department, enthusiastically unveils the research he is conducting with Pierre Marchal of the Swiss Electronics and Microtechnics Center (CSEM). They are designing the first computer chips capable of evolving by following rules borrowed from biological organisms. Like the latter, electronic devices created in this way can repair themselves without assistance. A patent filed two weeks ago now protects this particular form of artificial life.

The idea germinated two years ago, when new chips dubbed FPGAs (Field Programmable Gate Arrays), came on the scene. Manufacturers of electronic devices have since been able to dispense with designing specific chips for each application. All they have to do is code an FPGA microprocessor for a specific function that may range from a calculator to a washing-machine regulator.

### A Giant Code

An FPGA chip consists of a large number of strictly identical, interconnected electronic circuits. A specific code, made up of 0s and 1s, must be programmed into each circuit to give it a precise function.

The bright idea of Daniel Mange and Pierre Marchal is to program all of the codes for the whole chip into one of the circuits. This giant code describes all of the microprocessor's desired properties. Most important, it automatically duplicates itself from one circuit to the next, thereby invading the chip. Finally, only the part of the code that is specific to each circuit is activated, depending on the circuit's location. The analogy with the

biological world is obvious: Each cell contains the complete genetic code (genome) of an individual, but only certain genes can express themselves, depending on the location of the cell in which they are found.

### Spontaneous Repair

Why try to mimic the living world, when we have a classic method for programming codes into each circuit? "We don't yet know all the advantages our new technique might offer. But we have already discovered one very useful property: When a circuit fails, its codes can move to a healthy region of the chip. A mechanism of spontaneous repair occurs that would enable us to create highly reliable devices," explains Daniel Mange. For the process to work, the chip must contain a reserve of virgin cells.

The first, extremely simplified prototype was ready last November. But the researchers are still progressing, primarily by simulating their devices using specific software programs. Today, the feasibility of the new technology seems established, although concrete applications are still a long way off. One important requirement is the creation of much more powerful FPGAs. But Daniel Mange has already dreamed up a next step. "I proposed to Jean-Daniel Nicoud, director of the Microcomputing Laboratory, that we computer simulate the embryological development of a neural system."

Each circuit would correspond to an artificial neuron, giving the system two basic life processes. Its deterministic side would consist of code duplication, which is similar to cell division. In contrast, the chip's neural functioning would lead to the emergence of complex behavior from the simple rules the researchers would ascribe to each circuit.

Let's take the liberty of imagining an additional step, which is pure science fiction for now. If engineers were to couple the system with genetic programming techniques, the result could be a vast population of such systems, capable of evolving through reproduction and mutation. Such a development might make Hal, the computer dreamed up by Stanley Kubrick in "2001, A Space Odyssey," look like a rusty piece of hardware.

### Austria: AMS's 'Monocircuit' Phone Uses Five Times Less Components

*BR2306131793 Paris ELECTRONIQUE  
INTERNATIONAL HEBDO in French 10 Jun 93 p 18*

[Unattributed article: "Telecommunications Circuits—Austria Mikro Systeme Divides Number of Telephone Components by Five"]

[Text] The first "monocircuit" telephone in the world will use only 40 components, instead of more than 200 used in an average telephone.

The AS2531, which has just been introduced by the Austrian company AMS [Austria Micro Systems], integrates an improved speech transmission circuit, a numbers memory, a melody generator, and a ringing function—in short, all the functions necessary for a high-performance, medium-range, electronic telephone on a single chip. What is more, the telephone is programmable and can be easily adapted to the requirements of different postal and telecommunications administrations.

Utilization of the circuit, which also includes a squelch circuit and volume control for the listener, is expected to cut the number of components in the average telephone from 200 to 40.

The AS2531, manufactured in CMOS [complementary metal-oxide semiconductor] technology, is also characterized by very low power consumption, both during use and when idle. When the phone is not being used, the 14-number-capacity memory uses less than 0.1 microampere. The circuit operates in a range extending from 13 mA to 100 mA. A reinitialization routine integrated into the power supply ensures correct startup. In addition, a double Wheatstone bridge regulates the return loss (alternating impedance) and adjacent tone, since both these parameters are completely independent of each other. The AS2531 is available in 28-pin packages (SOIC [small-outline integrated circuit], PLCC [plastic-lead chip carrier], or DIL [dual-in-line]).

### NUCLEAR R&D

#### French-Dutch Superconductive Cyclotron Presented

*93WS0455J Zoetermeer SCIENCE POLICY in English  
Apr 93 p 24*

[Text] A unique new machine for the acceleration of atomic nuclei will go into operation in the Netherlands this year. The Accelerateur Groningen Orsay—or AGOR for short—will be located in the Nuclear Physics Accelerator Institute (KVI) at the University of Groningen. The accelerator is currently receiving its finishing touches in Orsay, France.

AGOR is a joint venture between the Foundation for Fundamental Research on Matter (part of the Netherlands Organisation for Scientific Research) and the French National Institute for Nuclear and Particle Physics. The accelerator will be ready in the spring. Later in the year, it will be moved to Groningen for use in nuclear physics and related research.

A cyclotron uses coils through which an electric current is running to generate a strong magnetic field which must be constant over a distance of some metres. The magnetic field ensures that the electrically charged atomic nuclei in the coils remain enclosed in the cyclotron, even when they are being accelerated. The superconductive coils used generate much stronger magnetic fields than

normal coils, allowing the atomic nuclei to be accelerated to much higher energy levels.

AGOR differs in two ways from other superconductive cyclotrons in that it can accelerate very light atomic nuclei—such as those of hydrogen—as well as heavy ones. This is thanks to the special shape of the coils and the magnetic poles.

The technique used in constructing the coils is one that has previously been used only in the construction of smaller coils. Superconductive coils of the size used in AGOR (diameter 2.6 m, height 0.5 m) have previously consisted of a large number of separately wound layers, impregnated for isolation, which are then stacked like pancakes with small spaces separating them. The spaces contain liquid helium, which keeps the coils superconductive by cooling them to very low temperatures. By contrast, AGOR's coils are wound in one unit and then impregnated with epoxy resin. The liquid helium for cooling the coils is therefore external to them. This makes the coils mechanically much more rigid, thereby enabling them to withstand the strong Lorentz forces generated in the strong magnetic field of 4.02 tesla (international unit of magnetic electricity).

This also reduces the chance of short circuits between the loops. The coils were recently turned on and tested—with no resulting problems.

#### **Siemens Participates in EC-Sponsored Nuclear Fusion Project**

*MI3006102793 Eschborn NACHRICHTEN FUER AUSSENHANDEL in German 1 Jun 93 p 1*

[Text] The EC Commission has awarded the European industrial group Citif/Italy, Framatome/France, NCC Ltd./Great Britain, and Siemens/Germany the contract for the European industrial contribution to the overall planning of the ITER fusion reactor. ITER (International Thermonuclear Experimental Reactor) is a demonstration plant for the first attempt at controlled nuclear fusion, planned jointly by the United States, Russia, Japan, and the European Community. Energy is to be produced with ITER not by nuclear fission, as in a nuclear power station, but for the first time by nuclear fusion, by fusing two light atomic nuclei to form one heavy atomic nucleus.

## **TELECOMMUNICATIONS**

#### **Italy: Alenia Spazio Develops Mobile Satellite System**

*MI0206133493 Rome SPAZIO INFORMAZIONI SPAZIO ITALIA in Italian Mar 93 pp 20-21*

[Article by Eng. Francesco Rispoli of Alenia Spazio, head of the ESA market: "The Cellular Telephone Via Satellite Has Arrived"]

[Text] Everybody knows how much mobile telephones are used and how the service has developed everywhere, particularly in Italy. Italy has in fact registered the highest growth rate and ranks fourth in the world with 800,000 subscribers. Experts foresee a continuous increase in the use of mobile telephones using more and more sophisticated systems that are specialized to suit the various types of subscribers. We are therefore passing from national systems to transnational systems such as the GSM [Special Mobile Group], which will enable personal telephones to be used in European countries, to systems that will enable us to travel around the world with our mobile telephones.

In this field a satellite is able to complement the traditional system on land when it is necessary to supply wide coverage as well as a specialized service for certain categories of subscribers, such as transport companies including train and aircraft operators, needing to communicate both with their own vehicles (closed circuit system) and with the external world using the telephone network.

#### **European Mobile Satellite System**

The European Mobile Satellite (EMS) system of the European Space Agency (ESA) began because of this and a preoperational service is scheduled to begin in 1995. The Italian communications satellite Italsat-F2 will in fact be launched during 1995 carrying the EMS that is being built by Alenia Spazio. Alenia Spazio heads the industrial consortium that includes, among others, Matra Marconi, ComDev, Ericsson, CASA [Aeronautic Constructions Company], and Siemens.

The EMS will cover a wide zone including Europe, North Africa and some eastern European countries in one single band (or cell), thereby avoiding shadow zones such as those typically excluded by land-based mobile radios because of low population density which makes them insufficiently remunerative in consideration of the required investment. In this respect the EMS could be of valid help to the transport companies that foresee an intensification of interchanges with the eastern European countries that lack telecommunications infrastructures and do not have cellular networks. The EMS lends itself as a concrete means of starting cooperation with the eastern European countries as part of the obligations that the European Commission has recently undertaken to help the development of their economies.

On the other hand the EMS is not starting off alone in the world. Similar initiatives are under way in the United States and in Canada with the joint M-Sat program, and in Australia with a system that is very similar to the EMS that will be put on board the satellite Aussat II. The typical subscriber target of the EMS is the transport company that has at least 10 vehicles travelling medium-to-long distances across several European countries. According to recent market studies there will be more than 5,000 transport companies in Europe in 1995, each having between 50 and 500 vehicles.

Most of these will be served by land-based cellular systems (GSM), but about 10 percent would certainly find a system via satellite advantageous. This percentage corresponds to over 500 companies having a total of between 30,000 and 40,000 vehicles equipped with radiotelephones operating via satellite.

The architecture of the EMS system comprises a land network, composed of mobile terminals (MSBN) for bidirectional connection with the satellite, and a fixed station (FES) situated within the offices of the companies that will have one or more satellite channels available (it is in fact possible to serve about 100 subscribers with one channel). The management of the calls and the assignment of the channels and relative charges will be entrusted to the control station (NCS).

The space segment consists of a transparent type repeater that receives the calls from the mobile subscribers in L band (1.5 Ghz) and retransmits them back to earth in Ku band (13 Ghz). In the opposite direction, the calls from the earth station in Ku band are sent to the mobiles in L band.

The EMS that will be carried by the Italsat-F2 satellite, weighs 43 kg and will need about 300W. More than 80,000 mobile subscribers can be served by this configuration for traditional telephone calls, data communications and/or telex.

Therefore the Italsat-F2 satellite will have a double function, having also to perform its principal telephone mission at 20/30 Ghz over the national territory, which is carried out today by its twin that has been in orbit since 1991.

#### Development Prospects

The EMS program can be considered as a concrete example of the use of satellites for communications between mobile units, even though an experimental stage is necessary before it becomes a service that will attract the operators' interest. Furthermore it is necessary for a decisive development of the land-based segment to follow parallel to the development of the space segment. It is foreseen that the land-based sector will be of greater interest from an industrial point of view.

The analyses that have been conducted so far show the service to be highly profitable particularly if it is considered in relation to the modest use of resources by the satellite. The EMS, in fact, has the same consumption as two television channels. The difference is that the returns are estimated as being between eight and 10 times greater. The cost of a one-minute conversation would vary between ECU0.5 and ECU1. This is certainly comparable to, if not competitive with, the land-based system.

The commercial spin-offs when the EMS comes into service are therefore quite promising and will be able to be taken up by European industry, that until now has often had to give precedence to the Americans and

Japanese, who have taken advantage of the economies of scale to defuse their own land stations in Europe. Investments in the space sector could therefore generate a return that is five to eight times greater than that of the land sector (a mobile terminal, in fact, should cost about ECU5,000, while a fixed station should cost about ECU50,000) as well as the returns for the operator who manages the service.

With the EMS, Europe has shown its desire to develop a new telecommunications service. Thanks mainly to the agreement of the Italian authorities, it has been possible to combine the EMS and Italsat-F2, without which the latter would have had to sacrifice its first mission.

#### Germany: Developments in Europesat Program Reported

93WS0490D Frankfurt/Main *FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT*  
in German 12 May 93 p 8

[“Telekom Halts TV Satellite Project”]

[Text] BONN (ap)—The German Post Office Department's Telekom has discontinued its participation in the “Europesat” TV satellite project, through whose offices high-definition television was to have been broadcast. The decision was based on the apparent lack of interest on the part of television programmers and the question of cost-effectiveness. The “Europesat” Project, which is a joint venture with France and Switzerland, was to broadcast in 28 television channels in the D2-MAC-Norm, favored by the EC, as well as the high-definition, sharper image HD-MAC-Norm.

In order to make the “Europesat” project cost-effective, Telekom, by its own reckoning, had to be able to market 12 of the 28 channels. To date, however, only six TV programmers have been found willing to conclude a binding user contract. And because the EC has reneged on introducing the MAC standard, the anticipated high demand for satellite channels has failed to materialize.

Taking the present financial situation into account, the Telekom board of directors has decided not to invest several hundred million German marks [DM] in “Europesat” at this time in view of the high risk factor. Telekom is seeking alternative projects with a substantially lesser risk factor. A decision of the European Community on the development of high-definition television [HDTV] failed to materialize early this week because of British objections. Since unanimity is needed to put the plan into effect, the question will again be debated at the next EC postal ministers' council meeting on 16 June.

### Italy: Evolution of GSM900, DCS1800 Cellular Systems

93WS0503A *Milan SISTEMI DI TELECOMUNICAZIONI* in Italian Mar 93 pp 6-16

[Article by Armando Colamonico, of Italtel, Milan: "GSM900 and DCS1800: System and Technological Evolutions of Next Generations of Base Radio Stations and Subscriber Equipment"]

[Text]

#### Introduction

Launched in 1992 in the countries of the European Community, the GSM digital cellular system found favor in extra-European countries as well. These will adopt it over the next several years according to their specific needs, and it is quite probable that, with the exception of the United States, Japan, and a few other countries, the GSM may become the world standard for digital cellular systems.

Increasingly difficult traffic conditions will necessitate the use of microcellular area-coverage for the GSM900 system and even more so for the DCS1800, and this will entail a substantially increased number of area "illumination" points, and an air interface (radio interface) of diverse characteristics in terms of numerousness of RF powers emitted and methods of use of radio facilities.

The widespread distribution of a large number of base stations over a generally urbanized area requires the installation of electronic equipment in unattended sites consisting of existing civil structures adapted for the purpose, and suitably positioned in the area to be served. Thus, in urban zones with a high density of potential subscribers, the installed or planned transmission infrastructure is a highly critical element.

The need of a widespread distribution of "illumination" points has focused the attention of researchers on antenna "remoters," consisting of equipment and transmitting facilities that enable most of the equipment serving various sites to be concentrated at a single location, while keeping to a minimum the amount of remoted or remoting hardware that must be placed at the antenna sites.

Since the radiating points in the metropolitan area of a large city can total several thousand in number, the objective we are faced with is the development of compact, low-cost, easily installed, micro base stations ( $\mu$ BS), to be located on the outside walls of buildings, on traffic lights, on street-lighting posts, etc.

An economically implementable system will require an architectural as well as technological quality leap in the development of the next generations of radio infrastructures. Architectural from the standpoint of enabling a flexible distribution of hardware, and technological from that of attaining a drastic reduction of the cost of

particularly complex equipment such as the BTS's [Base Transceiver Stations] based on GSM recommendations.

Insofar as concerns subscriber equipment, technological and commercial aspects will be paramount. The capacity for integration on silicon, the speed of development of new terminal equipment, and the commercial distribution networks will be basic considerations in deciding whether to proceed with the development of such products and in what forms.

Integrated circuits already on the semiconductors market, and others that will be available very soon, will make it possible—subject to possession of a solid systems-engineering and production know-how—for even non-leader companies to develop competitive portable terminals.

#### Widespread Area Coverage (Antenna Remoting)

GSM and DCS recommendations define several standard interfaces (Fig 1 [not reproduced]):

- A-interface, based on the following standards: 2 Mbits/sec-G703, CCITT No. 7;
- A-bis interface, based on the following standards: 2 Mbits/sec-G703, LAP D;
- Air interface, based on the following standards: 271 kbits/sec, 900 MHz, LAPDm (GSM); 271 kb/sec, 1800 MHz, LAPDm (DCS).

These interfaces enable the placement of the MSC [Mobile Switching Center], BSC [Base Station Controller], and BTS [Base Transceiver Station] remote from each other. These are voluminous equipments, however, and not suited to placement at unattended sites. The complexity of the BTS's, whose functional block diagram is shown in Fig 2 [not reproduced], has been the determinative factor on the part of the manufacturers in the development of equipment whose hardware, at the present state of the art, is not sufficiently compact and economical to satisfy a microcellular area-coverage scenario.

For these reasons, in all of the designs presented to date, the radio interface [air interface] is the only one taken into consideration for the remoting of illumination points.

The transmission facilities considered in this regard are for the most part fiber-optic and microwave systems.

#### Optical Fibers

The intrinsic quality of the optical fibers, as well as their smaller volume, enormous bandwidth, and low attenuation, render them extremely interesting for use in antenna remoters. Some recent proposals for use of fiber-optics in the development of PCN [Personal Communication Network] systems describe the possibility of transmitting analog signals at 900 or 1800 MHz over distances of up to 20 kilometers, without regeneration, to

transmitting antennas and from receiving antennas (transmitting and receiving antenna may be one and the same if a diplexer is used).

Figure 3 [not reproduced] shows this solution in block diagram form, applied to the BTS of Figure 2 (in the absence of diversity reception).

The combination of the signals from the TRX [transceiver] modulators modulates a laser linearly, which feeds the transmission fiber. In the  $\mu$ BS, the optical signal is converted into an electrical signal that, after being filtered, and its power amplified by a multicarrier linear amplifier, is radiated by the transmitting antenna.

On the receive side, the signal from the receiving antenna, after being filtered, is amplified by a low-noise amplifier [LNA], converted into an optical signal, and sent via the receiving fiber to the BTS, where, after being converted back into an electrical signal, it is transmitted to the TRX receivers.

This methodology helps to effectively reduce the functions that need to be enclosed within the remote site ( $\mu$ BS), with a drastic reduction of the cost of hardware. This approach entails the following considerations:

- 1) The signal transmitted via the optical fiber being analog, the nonlinearities of the transmitting medium and of the transducers must be kept carefully under control (nonlinearities of the fiber for multimodal light beams, of the optical connectors, of the laser, etc.).
- 2) The signal to be sent to the antenna is the summation of the frequencies used at the site, and this means that the power amplifier must also be linear or linearized to limit the intermodulation products. For example, to satisfy TACS and GSM specifications, which limit total conducted spurious to 36 dBm, an emitted power of 1 W per carrier requires a carrier/intermodulation ratio of the third order (C/IM3) above 66dB. In this case, the efficiency of the linear amplifier does not exceed 10 percent.
- 3) The level of the signal received by the antenna may be low, in which case the signal must be processed by an LNA to compensate for the attenuation of the fiber and, principally the high noise factor of the laser, which is of the order of 45 dB. Given the high dynamic of the signal in the uplink (approximately 60 dB), the LNA must suppress the intermodulation products below the noise level. Hence, the C/IM3 ratio must be around 75 dB and the gain greater than 40 dB.
- 4) The system represented in Figure 3 does not make use of the space diversity system's second receiving antenna. In such case, it becomes necessary to use a third fiber, or a frequency converter to allocate the signal coming from the second receiving antenna to a different frequency band and multiplex it on the same optical fiber.

- 5) For the operation and maintenance (O&M) of the remote site, an O&M channel must be provided by the system and multiplexed on the fiber.
- 6) Last but not least, if the receiving amplifier as well as the transmitting amplifier are not duplexed for redundancy, they become the critical elements as regards availability of the system, since a failure of either will put the entire site out of service.
- 7) On the other hand, the configuration described herein presents the advantage of being uncommitted—that is, not tied to a particular cellular system (TACS, GSM, DCS, or other)—in that it is completely transparent to the radio signal in the working frequency band. Another interesting capability of the remotes configured as in Figure 3 is that of being able to send (and receive) the signal to be radiated (received) at more than one site, thus realizing a distributed antenna system; that is, creating a radio coverage area (cell) whose irregular shape adapts well to the area to be served.

Figure 4 [not reproduced] illustrates a distributed-antenna system showing the distribution of the radio frequency to remote sites, and its concentration in the BTS, via passive optical couplers. In this manner, the same signal is transmitted simultaneously by various illumination points (Figure 5 [not reproduced]), causing the vehicle to receive the same signal at different times, given the varying distance of the vehicle from the stations and the possible differences in length of the optical fibers. The same applies inversely to the signal transmitted by the vehicle and received by the BTS via several optical fibers.

The effect is the equivalent of multipath fading and can be particularly detrimental to analog cellular systems. This is not so in the case of modern digital cellular systems, since the mobile stations as well as the fixed stations are equipped with adaptive equalizers designed to overcome these distortions. They can even take advantage of the reception of these simulated echoes produced by the diversity of transmission. The characteristics of the channel equalizers designed for the GSM and DCS system, for example, provide compensation for signals from  $\mu$ BS's at distances up to 5-6 km.

To obviate the critical aspects cited in the foregoing paragraphs, Italtel proposes an original remoting solution using fiber-optics. It is based on the particular architecture of the BTS902 designed in the R&S laboratories of its Radio Systems Business Unit.

This solution minimizes the number of optical fibers used, increases the reliable remoting distance of  $\mu$ BS's, and simplifies the optical/electronic conversions.

Referring to Figure 2, the generic TRX is represented as the combination of baseband [BB] functions (voice coding, channel coding, encrypting, formatting of the burst, and signaling relative to the traffic channels), the modem's more strictly radio transmission functions

(modulation, demodulation, channel equalization, and amplification), and the antenna branching functions (transmission combiner, reception multicoupler, and filters). A switching element designed to actuate the FH [Frequency Hopping] algorithm in baseband, and indicated by dotted lines, is interposed between the first two groups of functions.

The architecture of Italtel's BTS902 is represented schematically in Figure 6 [not reproduced]. To connect the BB functions and modem functions, a high-speed (10 Mbits/sec) data bus is provided, whose electrical standard is borrowed from the ETHERNET model.

It actuates a distributed multiplexing function and is equivalent to the switching matrix shown in dotted lines in Figure 2. This proprietary bus, which has been assigned the name of FLEXLAN<sup>®</sup>, consists of two coaxial cables, by means of which the frames connected to it may be remoted up to 150 meters distant, thus providing freedom of positioning of the hardware, which is generally rather costly.

The FLEXLAN<sup>®</sup> bus can be extended to over 30 km, without regeneration, by means of simple optoelectronic transducers.

This limit is not imposed by the fiber, but is rather intended to avoid introducing excessive cumulative delay. The digital signal sent via optical fiber is not very sensitive to the nonlinearities of the fiber and of the optical transducers (lasers and pin diodes), nor does the noise factor of these components create serious problems in the design of the data channels. Moreover, the channel is symmetrical; that is, the signals from BTS to μBS and vice versa have the same characteristics, or link-budget. Thus, the signals in both directions can be multiplexed on a single optical fiber (Figure 7 [not reproduced]), using two diverse wavelengths and the WDM [Wavelength Division Multiplexer] technique.

Low cost, simplicity, and reliability of a digital transmission system characterize this solution, which has the further advantage of maintaining the potentiality of the BTS intact, insofar as concerns modularity, equipment, output power, etc. Only one feature, which is already existent in the station architecture, is enhanced, namely, the capability of remoting the part of the system that is most closely connected to the radio interface; that is, to the radio transmission functions.

The reliability of the remote site is not affected, since the intrinsic redundancy of receiving diversity, and the nonexistence of a common amplifier, ensure the availability of the service.

A single BTS can also feed several μBS's at different remote sites (Figure 8 [not reproduced]). This case, of course, is not the same as that described in Figure 4, which is typical of a distributed-antenna system, in which the various illuminators use the same frequency. In Figure 8, each μBS is a cell with its own set of

frequencies. The only constraint binding upon this solution is that, for each BTS, the number of frequencies pertaining to the remoted cells must not exceed 15.

With a single fiber, it is also possible to remote a three-sector site with a maximum of five carriers per sector, and receiving diversity in each sector, for a total of nine antennas (Figure 9 [not reproduced]).

In the traditional case of remoting the radio interface, nine fibers—or six fibers plus frequency converters to serve the receiving diversity—and an equal number of optical-electronic/electronic-optical systems would be needed.

The complexity of the remoted hardware remains to be evaluated, insofar as concerns the two systems presented above.

While it is true that, when remoting the radio interface, only the transmitting multicarrier amplifier and the receiving LNA functions need be provided at the remote site, it is also true that the providing of these functions presents critical aspects from the standpoint of having to meet the requirements of carrier/interference ratio, signal/noise ratio, and the link-budget's gain and linearity requirements. This necessitates equipment whose complexity cannot be overestimated.

Remoting the transceiver parts, as proposed in the Italtel solution, the problem boils down to optimization in terms of cost and bulkiness of the hardware for functions that have already stood the test of time.

Both of the solutions considered call for a fiber-optic distribution typology of the star type. Other possibilities under study in Italtel's R&S laboratories include the development of fiber-optic buses. These could be used advantageously where the antennas must be distributed along major highways with a high density of telephone traffic.

A network architecture of this type that would further reduce the number of fibers used is not easily applicable to the remoting of the radio interface.

#### Microwave Links

Microwave radio systems operating in the 18, 28, or 32 GHz bands can be used in a manner entirely analogous to fiber-optic systems for the remoting of antennas.

Where an optic-fiber distribution system has not yet been cabled, it may be more advantageous to use more visible links. By using small directional antennas installed atop city buildings, area-illumination points can be distributed in star configuration.

The two alternatives discussed above in the fiber-optics case are present in this case as well. Since the microwave system must transport a radio-frequency analog signal whose power values are exceedingly asymmetrical in both the uplink and downlink sectors, the remoting of the air interface entails the same critical considerations as discussed above. The problems of linearity and gain of the electronics at the remote sites are also present in this case.

Alternatively, there is again the possibility of extending the Italtel BTS902's FLEXLAN® 10 Mbits/sec bus, with the creation of a symmetrical digital channel on a microwave link suited to the preserving of the reliability and all the capabilities of the station, including: high power levels, where necessary; receiving diversity; sectorial sites; etc. Insofar as concerns microwave links, the two alternatives differ from each other in the processing of the signal. In the first case, a frequency modulator/demodulator is used; in the second case, the modem is digital (PSK, QPSK, etc).

### Technologies

The technologies considered under this subheading are exclusively those relative to the terminals and to the BTS's of the GSM and DCS systems, which, from the hardware standpoint, are the only equipment with real innovative content.

The change of methods of accessing the mobile radio network, from FDMA/SCPC [Frequency Division Multiple Access/Single Channel Per Carrier] systems to FDMA/TDMA [FDMA/Time Division Multiple Access] systems, has completely revolutionized the design of the electronic equipment, mobile and fixed, for operation of the air interface. The realization of high-speed data channels whose band goes well beyond the coherence band of the transmitting facility has made it indispensable to use modulation/demodulation algorithms, the low-cost implementation of which was unthinkable only a few years ago.

The voice band compression algorithms used in the GSM are realizable only by means of powerful digital signal processors [DSP's], and virtually all the manufacturers of fixed and mobile equipment make massive use of these components. The GSM algorithms alone (channel equalization, channel coding/decoding, speech coding/decoding, etc) require a terminal-equipment computing power in excess of 30 Mips [million instructions per second]. In the BTS, this value is almost eight times higher, since each radio carrier transports eight channels of full-rate traffic. On the other hand, the analog and radio parts are simplified, since all of the baseband process and part of the modulation/demodulation are actuated by digital circuits. In substance: The considerable incremental complexity of this new equipment has found a valid aid in digital (DSP and ASIC [Application-Specific Integrated Circuit]) technology, whose growth has been skyrocketing in recent years.

As for the method of modulation, which permits suggestive and simple front-end radio designs and the development of new dedicated chip-sets, hand-held sets more compact than currently available analog sets can be expected to become available in a little over a year.

As for realizing an equivalent technological leap in radio infrastructures, the development times cannot be expected to be as rapid, owing as much to the technical

difficulties involved as to commercial and organizational considerations. Portable terminals have a widespread consumer-type market, and the large number of units sold facilitates the amortization of the heavy investments made in the development of notoriously complex ASIC's. It is also true, however, that in a scenario in which area coverage is achieved by means of microcells, as described in this article, the differences cited in this paragraph tend to diminish, since the stations involved, or at least their remotable functions, will have to be produced in such number and will have to have such compactness characteristics as to justify the investments in customization and in the use of other sophisticated technologies.

### Decision Support System Introduced at Italcable

93WS0503B Milan SISTEMI & IMPRESA in Italian Mar 93 pp 61-68

[Article by Luisa Stabile and Luca Gambetti, of Olivetti Information Services: "Development of a DSS at Italcable"]

[Text]

#### 1. Introduction

##### 1.1 Telecommunications Situation in Italy

Telecommunications in Italy are still undergoing a period of transition, which should end with the advent of the awaited definitive restructuring. The fundamental precepts of this restructuring were laid down by Law 58 of 29 January 1992. This law is expected to facilitate a rapid recovery of the positions lost by the Italian companies as a result of tariff differentials and the growing competition, which, by means of increasingly sophisticated technologies, can now easily circumvent the remaining fragile monopolistic barriers.

Italcable, in full synergy with the other companies of the STET Group, has positioned itself as the Group's "Global Operator" with responsibility for international telecommunications traffic and services, while maintaining leadership in international telecommunications on the domestic Italian market and continuing to capture terrain in the rest of Europe and in the world.

In this context, characterized by continuous and ever faster evolution, the role of Strategic Planning takes on increasing importance.

##### 1.2. Role of Strategic Planning at ITC

The role of the Strategic Planning function at Italcable (ITC) is to provide a reference point for strategic decisions and decisions relating to growth. It is to provide:

- the Company with ongoing strategic planning;
- the Company Management with the assistance necessary in deciding among company policy alternatives;

- the company's Business Lines the support they need to achieve a better balance between short-term and long-term objectives.

Strategic Planning must also analyze the marketing, economic, social, and institutional scenarios in which the company management finds itself having to operate, and the company's necessary internal and external links.

And Strategic Planning defines the Four-Year Plan, ensuring its coherence with the defined business objectives.

### 1.3. The 'Strategic Planning' Process

The Strategic Planning activity has an annual cycle. The phases of this cycle are:

#### Preliminary Phase

In this phase, Strategic Planning, through ad hoc studies, defines the commercial, technological, economic and financial, and socioenvironmental scenarios the Company will have to confront during the four-year period of the Plan. This is followed by an analysis of the Company's presence in the different businesses, with emphasis on potentially critical situations and gaps between capacities and demand.

#### Formulation of a Strategic Document

Upon completion of the preliminary phase, Strategic Planning produces a strategic document that sets forth the company's position, its strategic macro-objectives, and the guidelines to be followed by each Line and Business Unit during the four-year period.

A mainstream document is then drawn up that links the strategic macro-objectives and the individual strategy of each Line and Business Unit. The contents of this document are then presented in an especially intuitive manner through the use of graphical instruments (Ishikawa diagram).

#### Drawing Up of Strategic Plans

The strategic business aims having been defined, Planning, together with the Lines and Business Units, drafts the Strategic Plans. These Plans identify the macro-strategies, the key result areas, the indicators, the expected results, and the control procedures. The Strategic Plans are then forwarded to Operations Programming, which deals with the tactical aspects of the Plans.

#### Strategic Control

Following the definition of the Strategic Plans, the Business Units and Strategic Planning provide for the monitoring of the indicators and of the expected results, pursuing aims of efficiency and effectiveness. They also provide for qualitative-type evaluations of the evolving context.

#### Production of the Four-Year Plan

The flow of the activities described in the foregoing phases of the strategic planning process has as its natural outcome the production of the Four-Year Plan.

The Four-Year Plan is the most exacting study of those done by Strategic Planning at Italcable. This is because of the quality and importance of the information it must contain, and because of the quantity of resources used in drawing it up.

Because of the criticalness involved in the drawing up of the Plan, Strategic Planning at Italcable has equipped itself with an up-to-date technological infrastructure, and will begin testing a system—the Strategic Monitoring System—designed to correlate the efforts of each of its sectors, and enable the selection of data of strategic interest from that produced by each Business Unit.

#### 2.1 Overall Description of the System

Development of the Decision Support System [DSS] oriented on strategic monitoring, achieved by the PIAS Line at Italcable, began with the analysis and standardization activity that was instituted in 1990 and is still in progress as part of the strategic planning process.

With that activity as a point of departure, the system, developed as an evolutive prototype, has followed the planning process described in paragraph 1.3, step by step, to the point of becoming a flexible, continually evolving information processing infrastructure.

As of today, all of the qualitative and quantitative data comprising each Business Unit and Line plan can be entered and stored in the system, thus normalizing the analyses, assumptions, and initiatives generated by each Business Unit.

The availability within a single data base of the parameters indicated by each unit as the best suited to represent the evolution of the context in which it operates can thus enable early identification of threats and opportunities, and the rapid definition of response strategies.

In addition, the monitoring function, by collecting in standardized form the needs of each Business Unit, in terms of transmission, economic and financial, human, computer, and communications resources, enables a more rational distribution of those resources, while providing useful indications for the operational programming process.

By using the system, it is possible to know the quantities of resources required by all the Lines to meet the strategic aims contained in the mainstream document. It is also possible to compare the results attained by each action and the relative costs. The system, therefore, is not posited as an instrument for controlling the operative actions brought into being by the Business Units—a management instrument panel, that is—but rather as an instrument designed to support decision-making in connection with all aspects of the strategic planning process.

As for identifying the present and future users of the system, it must be borne in mind that, just as the structure of the Strategic Planning process provides for several levels of intervention, so also does the monitor software provide at least two levels of use (Fig. 1 [not reproduced]).

The heads of the individual Strategic Business Plans, and the PIAS professionals, are the system users at the first level.

The heads of the individual Plans find in the Monitor System a standardized and company-wide line planning instrument, enabling a comprehensive view of the whole. The PIAS professionals, on the other hand, use the product for the integral management of the Strategic Business Plans, from the moment of their definition to the printing of the definitive version of the Four-Year Plan, taking advantage of its editing, checking, and inquiry functions.

A second level of use of the system is planned, that will be characterized by the maximum possible aggregation and meaningfulness of the available data.

In this case, the users of the system will be the company's top management, which will then have available the business data necessary to monitor the correct deployment of the strategic actions that are a part of the mainstream.

The role of Strategic Planning, as the head of the monitor instrument, is that of dispatcher and integrator of the data, and supplier of synthesized information to the company's top management.

#### Aspects Connected With Implementation Problems

We shall now describe some aspects of the system that, although being purely technical, can help the reader to gain a better understanding of the underlying philosophy. The system was developed entirely within a Windows 3.1 environment, by automatically integrating the functional capabilities of several software products (Word for Windows, Excel, and Q+E) that were already in use by Strategic Planning. Therefore, no further training of the personnel proved necessary.

All the qualitative data (description of strategies, policies, key areas, etc...) and quantitative data (expected returns, necessary resources, estimated costs, etc...) are inputted to the system, using Word tables defined at the start of a new planning cycle.

The system automatically extracts the quantitative data from these tables, and files the data in a traditional database, making them available for guided consultation as indicated above. In a consultation phase, the system is completely mouse-driven, and is utilizable even by an inexpert user, or a solely occasional personal computer user.

Through the use of a LAN (Microsoft LAN Manager), the system is distributed. All the data in the system

reside in the network server, and are therefore accessible by all authorized users. To use the network's services, no operation is required of the user, except for insertion of the correct password.

#### 2.3 Evolution of the System

In order to complete the system, the following added functional capabilities will be made operational within the very near future.

**Application of Analytical Technologies.** Besides presenting the expected returns of each Strategic Plan, the system will be able to navigate among the data and the what-if analysis, thus furnishing further elements for the perception of the phenomena subtended by the data.

It will therefore be possible, after having examined the trend of any one phenomenon, to obtain the list of the phenomena logically connected with it. This will be achieved by implementing in the prototype a navigational function that, departing from any parameter whatever, and following a succession of logical associations among the data that are being checked, will enable a complete study of the strategic planning data base.

**Example of Study:** *Charges against budget, Company occupational mix, Market share.*

Once this function has been incorporated, and after having determined which indicators are linked to which, mathematical relationships among the indicators can be hypothesized. Once these relationships are determined, the values of one or more parameters can be varied to evolve simulations and determine the effects had on the rest of the system by the variations introduced.

**Example of Study:** *If the number of salesmen is increased by 5 percent, what impact can this be expected to have on Italcable's market share?*

**Diffusion of the System:** Solution of the technological and organizational problems inherent in the installation of the system in various remote offices (upper management, Business Units, and Lines) linked to the PIAS data base for operations, for allocation of charges, or for studies.

A study is under way at this time to evaluate the desirability of installing the system in portable (Notebook) personal computers, so as to enable the PIAS professionals to check the planning process "on site," alternating between moments of discussion with the Lines and moments of work on the strategic plans.

Further developments would enable the progressive displacement of the analyses made toward the outside world.

The phenomena monitored will no longer need to originate exclusively from within the company, but can also and probably should originate above all from circumstantial realities, with particular attention to the data inherent in the strategies of Italcable's competitors,

whose presence on the Italian market can be expected to gradually generate more and more competitive pressure on Italcable.

#### Appendix: 'Strategic Planning' and Decision Support Systems

Is it possible to build automatic systems that help to improve the quality of the work of those, in business, who are responsible for strategies? We shall try, in the following pages, to respond to this question by describing methodologies and techniques underlying the strategic monitoring system in use by the Italcable Strategic Planning Line.

First of all, however, we wish to review briefly the evolution of decision support systems, so as to enable the reader to evaluate the innovative content of the system under discussion.

The desire to utilize the instruments made available by the advent of computers, not only for the automation of company procedures, but also to support management activity, goes back to the early 1960's.

A myriad of symbols and slogans have accompanied the birth and evolution of classes of systems dedicated to management: From MIS's (Management Information Systems) to DDS's (Decision Support Systems) [as published], to EIS's (Executive Information Systems). When technologies typical of artificial intelligence were "hard-wired" into a system, it was referred to as an EXSS (Expert Support System).

Prevented as we are by space limitations here from describing in detail the characteristics of each class, we refer the interested reader to the works and articles cited in the bibliography.

For our purposes, it will suffice to define a broader category that includes all the classes cited: business intelligence systems. This is the category of systems designed to provide management, effectively and efficiently, all the information necessary to improve the quality of its decisions.

The most widely available products pertaining to this category consist of systems capable of displaying on personal computers—or on a terminal of a company's host computer—the trend of a set of phenomena, called "indicators," and of applying simulations to these phenomena, using techniques of a statistical type.

It is difficult to evaluate the benefits of a system of this kind, in terms of acquisition of a clear strategic advantage over competitors. Indeed, researchers found distortions in managerial performance stemming from the use of EIS's and DDS's. These products tend to be transformed into a mirror of sorts, in which the manager ends up finding all his own convictions confirmed and reinforced. His mistaken ones as well.

A "new-generation" software, according to authoritative research by experts in the study of managerial performance, should put the manager's certainties to question to the maximum extent possible, and until it gives rise to a round of brainstorming between man and machine.

The decision support system developed by Italcable's Strategic Planning takes these new recommendations into account, as we shall see later in the developmental process, by comparing the company strategic guidelines with those of each business unit, and bringing out abnormalities and contradictions between them, so as to provide top and middle managements with cause for reflection on the definition of the key lines of action to be pursued.

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#### Germany: Heinrich Hertz Institute Develops HDTV Projection System

MI3006102193 Bonn TECHNOLOGIE-NACHRICHTEN MANAGEMENT-INFORMATIONEN in German  
28 May 93 pp 8-9

[Text] The first large image displays with diagonals of around 2.5 m exploit the advantages of high-definition television (HDTV) to the full. Conventional television tubes have not been able to handle diagonals exceeding 90 cm, and, as high-luminosity large-format flat displays will not be available for the foreseeable future, projection displays have proved the best alternative.

The projection system developed at the Heinrich Hertz Institute [HHI] of Communications Technology in Berlin centers on a light valve that uses the electronic signal from the TV tuner or videorecorder to impresses

the image information onto the luminous flux from a strong projection lamp. It works somewhat like the celluloid film in a cinema projector, though with two major differences:

- Unlike film, it works by reflecting instead of by transmitting light;
- The luminous flux is not controlled continuously, as with the film running between the lamp and the projector lens: Every pixel is individually (discretely) controlled electronically.

The light valve chip that performs this function is an outwardly mundane, rectangular mirror, 2.36 x 1.41 cm in size, although the microscope reveals the details. One side of the silicon substrate is coated with a thin silicon gel film around 3 microns thick, which is in turn plated with an ultra-thin (around 0.05 micron) silver film. The projection light is reflected on this film, and is converted into pixels by means of electrostatic forces. This permits the image-forming modulation of the luminous flux, as experts call the impressing of image information. The process is controlled from the reverse side of the carrier, the entire surface of which is divided into pixels. Lattice-shaped wiring makes each of the 196 x 328 pixels of the carrier addressable. A minute electronic circuit (two transistors and two capacitors per pixel) ensures that when a voltage (of around 20 V) is applied, the mirror layer on the other side bends upwards or downwards at particular points by up to 0.1 micron. (By way of comparison, a human hair is around 100 microns thick. If the pixel resolution of the human eye depends on the size of the retinal cone, the pixel on the retina measures about 4 x 4 microns.)

The active control matrix was developed and produced using silicon CMOS [complementary metal-oxide semiconductor] technology with 2-micron line widths on behalf of the HHI at the Fraunhofer Institute of Micro-electronic Circuits and Systems (IMS) in Duisburg. The Ecole Polytechnique in Montreal was also involved in producing the high-precision mirror layers. The color-capable dark field projection system (three light valve chips for the ground colors red, green, and blue) was developed as part of the project funded under the Federal Research Ministry's Information Technology Program in cooperation with the Wetzlar firm of Docter Optics.

Progression to HDTV applications no longer presents any basic technical problem, but is simply a matter of scaling up. The 72 x 72 micron pixel size already meets television requirements. To achieve the full number of HDTV pixels (around 2.4 million), the light valve chip would need to be 10 times larger (requiring full wafer integration for manufacture), and the individual pixels would have to be halved along both axes (to 32 x 32 microns), which is undoubtedly feasible.

The demonstration mock-up produced at the HHI under Professor Gerhard Mahler and Dr. Reimund Gerhard Multhaupt is a precompetitive development model. It has provided the first-ever demonstration of the viability of a complete image-forming system based on metal-plated elastomer layers, including extended time tests. The research project has thus reached the stage where development for production can begin. The system can be used in professional applications, such as video projection in auditoriums or HDTV projection in cinemas.

## AEROSPACE

### Brazil: Goldemberg Urges Creation of Civilian Space Agency

93SM0329X Sao Paulo *O ESTADO DE SAO PAULO*  
in Portuguese 22 Jun 93 p 3

[Commentary by former Minister of Education Jose Goldemberg, who is also a former rector of the University of Sao Paulo and a former Secretary of Science & Technology]

[Text] The President of the Republic recently sent the National Congress a bill that would create the Brazilian Space Agency, to be "civilian in nature." This proposal was sent at the same time as measures pertaining to the administration's economic program and, it seems, will receive speedy attention from the Congress. This would begin the revitalization of the Brazilian space program, which has suffered various kinds of limitations on its development, but still has achieved a reasonable degree of success.

At present, the space program is being carried out primarily by three organizations: The National Institute of Space Research (INPE), the Aerospace Technical Center (CTA)—both in Sao Jose dos Campos—and the Alcantara Launch Center, in Maranhao State.

The CTA, which belongs to the Ministry of Aeronautics, has concentrated its efforts in the rocket propulsion and the construction of a system capable of launching man-made satellites into space.

The test facility for these launches is the Alcantara Base, which will probably become Brazil's "cosmodrome," since it is magnificently well situated right on the equator. The significance of this location is that it is easier and more economical to launch satellites from this base than from any other base situated at higher latitudes, such as Cape Canaveral in the United States, Baikanour, in the Soviet Union, or even Kourus, in French Guiana.

INPE is subordinate to the Ministry of Science and Technology. It not only does space and meteorological research, but has also developed the capability—in collaboration with this country's industry—to build the satellites themselves.

The proposed space agency would coordinate these activities, replacing the Brazilian Commission for Space Activities (COBAE), now chaired by the Minister-Chief of the Armed Forces General Staff (EMFA).

The first feature of the new agency is that it will be a civilian agency, thus dispelling the false image that now prevails, i.e., that the Brazilian space program is of a military nature. Furthermore, it will be a semi-autonomous agency [autarquia] with responsibilities for execution (not just an advisory body, as COBAE is), and would have its own staff.

The second characteristic is its direct link to the Office of the President of the Republic, which gives it a hierarchical status that COBAE does not have.

These two features should give the agency more flexibility in concluding international agreements in the field of space activities. By their very nature, such activities require such cooperation, not only to accelerate local technical development, but to promote the efficient use of the Alcantara cosmodrome.

Another task that the agency could perform, with a good chance of success, is to negotiate Brazil's admittance into the Missile Technology Control Regime (MTCR), an informal club whose members are countries that have mastered space technology. Membership in this club would facilitate access to space technology.

Experience in other fields has shown that the greater our national capability, the greater the extent of international cooperation that can be obtained. For example, we need to master the technology used to launch satellites into space, and the nations that are more fully developed in this area have set up obstacles to keep other nations from obtaining it, out of fear that it will be used for military purposes.

Indeed, space technology does have a "dual" nature, i.e., it can be used for both peaceful and military purposes, as is the case with nuclear technology. The only way to remove these obstacles and gain access to the necessary technology is to establish our program's credibility as a peaceful, not military, effort.

Establishment of the space agency will certainly help in this regard, by creating the conditions for strengthening the Brazilian space program without losing our independence in this area.

There are obvious commercial reasons for us to use the Alcantara facility as the base for launching satellites that orbit at low altitudes. Satellites of this type, for telecommunications use, will be extraordinarily important in the future. A major part of the necessary infrastructure has already been built at Alcantara, and we could soon enter the market with satellite launchers installed in cooperation with other countries, until we build our own. This possibility was seriously discussed on the occasion of the launch of INPE's "green" (data collection) satellite; INPE ended up hiring an American company to do the job.

The potential for international cooperation is great, and will increase with the establishment of a civilian space agency like NASA (the U.S. space agency).

Our space program has in fact been set back considerably because of problems in obtaining funding with the necessary regularity, and an inability to offer adequate salaries. The proposed space agency, as part of the Office of the President of the Republic, will be in a better position to remove the existing obstacles.

**Brazil: Russian Scientists Cooperating in Magnetic Field Study**

*93WS0495A Rio de Janeiro MANCHETE  
in Portuguese 15 May 93 pp 86-87*

[Article by Durval Ferreira]

[Text] There is another hole in the earth's atmospheric layer, besides the ozone layer over Antarctica: it is that of the magnetic field, which scientists have termed a Brazilian anomaly. Particles nuclearly loaded with cosmic rays easily penetrate this opening, and it is not yet known whether this is good or disastrous, and whether or not it affects humans or influences the climate. To study and evaluate what is happening with the magnetic hole, located on a strip extending from Santa Catarina to Rio de Janeiro, Unicamp [Campinas University], in Campinas, Sao Paulo, contracted Russian scientists to work together with the Brazilians. The mystery is, more or less, the following: At the poles, that protective magnetic field measures 0.70 gauss (a measurement of intensity) on the earth's surface, the highest on the planet. At the equator, the intensity declines to 0.40 gauss, nearly half; and in the Brazilian anomaly, it is 0.20 gauss, the lowest in the world.

It is this that the Russians, Yuriy Stozkov, Galina Pugacheva, Anatoly Gusev, and Vladimir Zhavkov (the latter working at the Institute of Space Research (INPE) in Sao Jose dos Campos, Sao Paulo), with the Brazilian team headed by Inacio Malmonge Martin, of the Cosmic Ray Department at Unicamp's Gleb Wataghin Institute of Physics, want to study. The cosmic rays coming from remote regions of the universe and from the sun become fragmented in nuclear collisions with other particles upon reaching the earth's upper atmosphere. They lose energy and produce other secondary particles, which undergo further fragmentation and penetrate the lower atmosphere. That penetration is facilitated by the hole of the Brazilian anomaly. Whether this is good or bad is what it is desired to learn.

With their space satellites and research, the Russians are ferocious on the subject. Suffice it to say that they have a geostationary satellite over Brazil, always at the very site of the Brazilian anomaly. Inacio Malmonge Martin, who did research in the former Soviet Union's most advanced institutions devoted to physics, was the one who made the effort to bring the Russians to Campinas.

**Problem: Is the Radiation Good or Disastrous?**

"At zero cost," he comments, referring to the access that the Brazilians obtained to the scientific data in their possession, supplied systematically by the satellites in orbit. The costs of the satellites and their consecutive launches are vastly greater than what is being spent on the Russians' salaries. And another one of them, Professor Leonid Lazcetin, a cosmic ray specialist, is already packing his bags to come as well.

Gusev and Galina are engaged primarily in studying the dosage of radiation received by astronauts in space, especially those who remain in the MIR orbital station for several months. The research done by the pair (who are actually husband and wife) also extends to solar activity and the variations in radiation dosages in the earth's lower atmosphere. What is being awaited from these scientists, who have come from their cold climate to do research in the Brazilian tropics, is a response that could be a relief as well as another headache: Is that radiation, penetrating the earth's magnetic field in a part of Brazil where the hole is deepest, good or disastrous, healthful or pernicious? At least one indication has already been given: If the astronauts receive radiation, aren't we, the natives of that region with the magnetic field anomaly receiving the same dosage? Let the Russians observe. They will give the response.

**BIOTECHNOLOGY**

**Brazil: Industrial-Scale Production of Diagnostic Enzymes Begins**

*93WS0463B Sao Paulo GAZETA MERCANTIL  
in Portuguese 6 Apr 93 p 12*

[Article by Sergio Adeodato in Rio]

[Text] Brazil has begun producing enzymes for diagnosing diseases through genetic engineering, on an industrial scale, offering a 50 percent reduction in the end price, compared with that of similar products currently being imported.

These enzymes include Taq Polymerase, the principal component used for diagnosis by PCR (polymerase chain reaction). It is capable of amplifying and detecting within a few minutes parts of the genetic code of microorganisms causing diseases in humans.

The enzymes are being manufactured in the Molecular Biology and Infectious Disease Diagnosis Laboratory of the Oswaldo Cruz Foundation (Fiocruz). The scientist Wim Degrave, of Fiocruz, explains: "The plan is to meet the national demand for enzymes used for research and diagnosis until the Brazilian biotechnology industries achieve the capacity to absorb that technology."

Those substances, used as tools for revealing the genetic code of microbes and of humans themselves, are produced naturally by bacteria as a defense against the invasion of foreign genetic materials, such as the bacteriophage viruses. When attacked by those agents, the bacteria release enzymes that cut off the DNA of the virus, halting its action.

As those enzymes are synthesized naturally in small quantities, to make their large-scale manufacture economically feasible and more efficient, the Fiocruz researchers are injecting "Escherichia coli" into other types of bacteria more common in the environment.

These are genes that codify the production of those substances in other microorganisms.

To produce the Taq Polymerase used in the PCR method to duplicate pieces of the genetic code that characterize a certain microorganism, the scientists are cloning in "Escherichia coli" some genes of the bacteria "Thermus aquaticus," a natural producer of the enzyme.

Using a 5.5 liter fermentation tank, Fiocruz has succeeded in producing up to 100,000 units of Taq Polymerase annually. This is sufficient to make 20,000 diagnoses by PCR, meeting the entire national demand, at a cost ranging from \$0.50 to \$1.00 per unit. The income accrued by Fiocruz is being reinvested in research on the diagnosis of tropical diseases.

Degrave estimates that, "The market for enzymes to be used for PCR will multiply when private laboratories begin using this diagnostic method routinely. It is the most modern existing in the world." He reports that in Brazil this technique is still confined to research laboratories in their molecular biology studies.

Another area to be explored by Fiocruz is the production of enzymes that are an alternative to Taq Polymerase, already being applied in other countries for diagnosis by PCR. Examples of these are TTH, produced by the bacteria "Thermus thermophilus"; Vent, synthesized by the "Thermococcus litoralis"; and Deep Vent, obtained from the bacteria "Irococcus furiosus," discovered in volcanic larva in the ocean subsoil. It is the only one resistant to temperatures higher than 120 degrees centigrade.

Fiocruz is also producing 500,000 units per year of the enzyme BSPR-I, isolated from the bacteria "Bacillus sphaericus," and used for genetic identification in paternity tests. The product, unprecedented in the country, is being sold to private laboratories at \$13 per lot of 1,000 units. In other countries, the enzyme used in paternity tests is HAE-III, isolated from the bacteria "Haemophilus aegyptius."

Also manufactured are 2 million units annually of the enzyme ECO-R-I, applied for cutting off DNA in molecular biology research. It has the potential for being used industrially to identify "Tripanosoma cruzi," which causes Chagas' disease.

Another enzyme, BCE-243, synthesized by Fiocruz itself for use in research, is being evaluated at the Joinville Biotechnology Center, which plans to produce it on a large scale to supply world genetic banks. This is an enzyme with high value added, costing \$200 per lot of 1,000 units on the international market.

[Box, p 12]

#### Roche Has the PCR Patent

The Roche laboratory, holder of the international patent on PCR, purchased from the American firm, Cetus, for

\$300 million in 1991, is waiting for the decision on the new industrial property code to assert its rights to the use of that technique in Brazil.

Silvio Reis, Roche's marketing manager for PCR, claims: "The patent covers the PCR methodology for diagnosing diseases and producing the enzyme Taq Polymerase, which is essential for that process." He reports that the company has already registered the technology in the United States, Japan, France, Germany, Great Britain, Spain, and the Netherlands; and is about to obtain the sole patent for the European Common Market. The world market for PCR, estimated for 1994, is \$1 billion.

In Brazil, a country that should be participating in that market with a share of about 2 percent (\$20 million per year), Roche is launching its first diagnostic kit for PCR. That first product is capable of diagnosing chlamydia, a disease sexually transmitted by bacteria. By July, the company plans to begin the marketing of tests for precise and more rapid diagnosis of AIDS (HIV-I) by genetic engineering: a market estimated at \$1 million per year in Brazil. Also this year, kits will be introduced in the country to detect tuberculosis and type C hepatitis.

In all countries in which it has a registered patent, besides selling the ready-made kits, Roche charges royalties for application of the PCR diagnosis methodology, for profit-making purposes. Reis reports: "For research centers, we usually grant what is called a label license: a license for use of the method without paying royalties." He adds that this strategy could be repeated in Brazil, after the decision on the new code for patents.

Wim Degrave, of Fiocruz, gives this analysis: "If the new legislation doesn't call for the retroactivity of patents, we could produce Taq Polymerase to diagnose common diseases in Brazil without having to pay Roche. That would make the national laboratories less dependent on imports."

## ENERGY, ENVIRONMENT

#### Brazil: Environmental Information Network Linked to UN Program

93WS0494A Sao Paulo GAZETA MERCANTIL  
in Portuguese 6 May 93 p 17

[Article by Virginia Silveira from Sao Jose dos Campos]

[Text] This week, the National Institute of Space Research (INPE) opened the first computerized global resources information data bank (GRID) in Latin America. The GRID is part of the United Nations Program for the environment. According to Gilberto Camara, chief of the INPE's image processing division, the data bank will be integrated with an international communication network furnishing data on the status of the environment throughout the planet.

This network, existing in nine countries in the world, will have access to an extensive data base containing information on the tropical forests of South America, especially in the Brazilian Amazon Region, including data on deforestation, burning, and changes in the region's climate. According to the INPE's general director, Marcio Nogueira Barbosa, the establishment of the Brazilian GRID was made possible through a cooperation plan signed with IBM of Brazil in November 1991.

As part of that cooperation agreement, IBM allocated \$4.5 million worth of equipment (donating 10 RISC-6000 work stations), and provided the entire infrastructure needed to support the project. The program also includes the development of software to process geo-referenced information (Spring).

According to Nelson Ortega da Cunha, manager of IBM's Scientific Center, the system furnishes the user with applications for digital earth modeling, spatial analysis, and access to the data bank, as well as image processing, map production, and cartographic projections. Spring was developed by INPE's image processing division, with support from Embrapa [Brazilian Agriculture and Livestock Research Enterprise] and from the IBM scientific center in Rio.

According to Nelson Cunha, the activities associated with the agreement signed with IBM will continue until December 1994, but may be extended for a few more years.

The Brazilian GRID is a result of a memorandum of understanding signed between the Ministry of Science and Technology and the United Nations Environmental Program (PNU-MA) in June 1992, during the UN Conference on the Environment and Development (Eco-92).

#### **Brazil: Commercial Software for Satellite Data Ready**

*93WS0496A Sao Paulo O ESTADO DE SAO PAULO  
Informatics Section in Portuguese 3 May 93 p 16*

[Article by Liana John]

[Text] Sao Jose dos Campos—On 10 May, during the Congress on Remote Sensing in Curitiba, the National Institute of Space Research (INPE) will launch the first commercial version of the Spring software, which speeds the processing of satellite images, maps, and cartographic data. The program was developed with the backing of the Environmental Monitoring Croup (NMA) of the Brazilian Agriculture and Livestock Research Enterprise (Embrapa) and IBM's Scientific Center, to replace two other older programs. The latter, also from

the INPE, are: the Image Processing System (Sitim) and the Geographic Information System (SGI).

In the Sitim, images of environmental satellites are filtrated and interpreted to analyze soil use, plant cover, urban growth, the environmental impact of hydroelectric plants, and roads. In the SGI, all the cartographic information on a given region: road network, rivers, and administrative boundaries, is digitalized.

To prepare a zoning, it was necessary to "manually" combine the maps produced by the two systems, because the Sitim ran on DOS and the SGI in a UNIX environment. Gilberto Camara, of the INPE, explains: "Spring does everything that the other two do in a single machine and a single environment. It has the advantage of also being compatible with the data bank managing systems existing on the market."

Spring runs on UNIX at the IBM RISC/6000, Sun Sparc, and Silicon Graphics stations, and costs nearly \$20,000: three times less than its foreign competitors. It also accepts a larger volume of data without the memory problems that occurred in the PC. To obtain an idea, the satellite image of the Campinas metropolitan region alone consumes 80 Mb.

#### **System Guides Development**

Satellite images and geographic information systems are the best available instruments for planning the development of the Amazon Region, with less environmental impact. With the satellite, it is possible to obtain a rapid, frequent and, simultaneously, full and detailed view of the changes that are occurring in the forest, without having to traverse kilometers of unstable roads and insurmountable vegetation.

With some field work and a few hours with a computer, one learns more about the deforestation or pollution caused by prospecting within the boundaries of the Amazon Region than would be possible in months of direct inspection. That satellite information can be combined with maps of the soil and the hydrographic network, relief maps, and maps of the road network and urban centers to help produce updated, detailed, complete maps of each region.

On the basis of those documents, planning can be achieved for agriculture and livestock, and the creation of new roads, new parks, and development enclaves, always considering the suitability of each area focused on. It is what is called zoning, and can include additional data, such as census information, and economic, social, and ecological indicators.

This is particularly important for a country such as Brazil, which has had under-utilized and often unavailable data. It needs this information to guide the planning of development in regions on the economic frontier.

## SCIENCE & TECHNOLOGY POLICY

### Brazil: Deputies Seek Further Debate on Nuclear Accords

93SM0329Z Sao Paulo *GAZETA MERCANTIL*  
in Portuguese 25 Jun 93 p 6

[Article by Brasilia correspondent Luiza Pastor, with boxed material contributed by Brasilia correspondent Maria Helena Tachinardi]

[Text] Deputies Marcelo Barbieri (PMDB-SP) [Brazilian Democratic Movement Party—Sao Paulo] and Miro Teixeira (PDT-RJ) [Democratic Labor Party—Rio de Janeiro] yesterday sent a request to their party leaders that the "for extremely urgent consideration" label be removed from the three nuclear safeguard accords being considered in the National Congress. The congressmen also want to have the Chamber of Deputies Committee on National Defense hold a series of debates to clarify points in the agreements that they still consider "not very clear." The proposal will be discussed on Tuesday, at a meeting of the leadership.

The decision to forward the request was made by the congressmen after the round table held by the committee to debate the subject of the safeguards ended without a consensus on fundamental points in the agreements. The principal source of disagreement is the question of prior authorization for "special inspections" at facilities where the inspection agency suspects nuclear activity is taking place.

"The way the bills read, those inspections can be requested in such a way as to open up to outsiders' eyes the technology that is being used," warned Barbieri, who advocates a new, "intermediate," wording for those parts of the agreements. This alternative, he argues, will permit checking into possible deviations from the rules on nonproliferation of nuclear weapons, while preserving the technology developed by Brazilian experts, who do not have access to foreign advanced technology in the field because Brazil has not signed the treaty on sensitive technologies.

The problem holding up the accords in the Chamber of Deputies is the same one that occurs every time the government concludes an international agreement on a strategic subject. Under the law, the legislators have the power to approve or reject the agreements, but not to amend them. So the only alternative to a text that Congress finds unsatisfactory is the drafting of a new agreement to be reassessed by the countries involved, renegotiated, and then resubmitted to the Congress.

So, if the legislators want to amend the agreements, that will mean starting the whole process over again, the process that finally led to the signature of the texts by the two countries, something the government finds to be a problem for its international negotiations.

One participant in yesterday's debate, Counselor Roberto Jaguaribe, head of Itamaraty's Department of Sensitive Technologies, warned that postponing approval of the agreements "would have negative repercussions for this country abroad," but preferred not to say what those repercussions might be. In fact, such repercussions may be provoked at some point in the future by an issue that is much more serious in the eyes of the world: all during yesterday's debate, several deputies were urging that the article of the Constitution that restricts the use of nuclear energy to "exclusively peaceful purposes," be deleted during the upcoming constitutional revision. The critics call the provision "absurd self-discrimination."

Of the three agreements on the agenda, one dates from last year and establishes a quadripartite committee to monitor the safeguards of the agreement signed in Vienna by former President Collor; another relates to the bilateral Brazil-Argentina agreement; the third includes a series of amendments to the 1967 Treaty of Tlatelolco that were approved at the General Conference of the Organization To Ban Nuclear Weapons in Latin America and the Caribbean (OPANAL).

#### [Box p 6]

#### Concern at Itamaraty

Itamaraty is worried that Brazil's partners, who possess sensitive technologies coveted by the government and Brazilian companies, such as supercomputers and precision engineering equipment, will start wondering about a possible "retrocession" as regards nuclear policy for peaceful purposes in this country.

This, in short, is the concern of Brazilian diplomats, given the possibility of a significant delay in gaining approval of the amendments to the Treaty of Tlatelolco and of the quadripartite agreement signed in December 1991 by Brazil, Argentina, the Brazilian-Argentine Agency for Accounting and Control of Nuclear Materials (ABACC), and the Vienna-based International Atomic Energy Agency (IAEA).

In the case of the amendments to the Treaty of Tlatelolco, which prohibits nuclear weapons in Latin America and the Caribbean—amendments approved by the Brazilian government along with Argentina, Chile, Mexico, and other member countries in the last half of 1992—Brazil is behind schedule in comparison to Argentina, where the changes in the treaty were approved by the Senate and by all the committees in the Chamber of Deputies and now only await approval by the full Chamber.

Day before yesterday, however, the Argentine government failed in its attempt to put ratification of the treaty on the agenda. The Argentine Congress rejected the proposal by 70 votes to 59. Ratification will be discussed again there next Wednesday.

**Brazil: New Law on Promoting Computer Industry****New Law Passed**

93WS0443A *Sao Paulo GAZETA MERCANTIL*  
in Portuguese 6 Apr 93 p 1

[Report by Luiza Pastor from Brasilia]

[Text] The partial regulations for Informatics Law No. 8,248, published yesterday, reinstated the criteria for granting tax incentives to business firms in the informatics sector. The companies will be able to claim exemption from the Tax on Manufactured Products (IPI) through the Ministry of Science and Technology, by showing the national value added of their products, quality levels consistent with national and international standards and certification, price levels and competitive conditions compatible with those of their international counterparts, and investment of at least 5 percent of their gross billing in research and development.

Multinational companies must show, in addition to the foregoing data, export programs calling for an external sales volume at least equal to the amount of unpaid tax, and a positive export balance compared with imports. According to the informatics coordinator of the Ministry of Industry, Commerce, and Tourism, Dorgival Brandoao, those requirements may nevertheless not serve to make a distinction between national and multinational firms.

Investments in research and development may be deducted from the Income Tax [IR] at a rate of up to 50 percent of the amount owed. Corporations in any industry may deduct up to 1 percent of the IR owed, if they purchase an equivalent value in stock shares of informatics companies, provided that they do not belong to the same group or conglomerate.

Decree No. 792 did not provide regulations for Article 3 of Law No. 8,248, which stipulated preference for Brazilian firms with national capital in purchases of informatics goods by the federal public administration.

**Text of Law**

93WS0443B *Sao Paulo GAZETA MERCANTIL*  
in Portuguese 6 Apr 93 p 14

[Report by Luiza Pastor from Brasilia]

[Text] After five months of intense negotiations, and two and a half years of delay, yesterday, the Official Gazette of the Union published President Itamar Franco's Decree No. 792, containing partial regulations for Law No. 8,248, on the informatics sector. However, the main advantage specified in the law for firms with rational capital, namely, preference in purchases made by the government, was not included, and its regulations have been postponed once again.

The law's regulations call for exemption from the Tax on Manufactured Products [IPI], provided that the informatics companies prove the existence of a minimum local value added, a price compatible with that of a similar international good or service, quality (gauged by national and international standards, and required through certification by an independent agency), and the company's technological expertise.

According to the office chief of the Ministry of Science and Technology, Oscar Klingel, "At first, those requirements may not always be made cumulatively; each case will be a separate one to be analyzed." He also gave a reminder that, for multinational firms to benefit from this IPI exemption, they will have to submit an export program with a minimum number of sales abroad equivalent to the unpaid tax, or a positive export balance compared with imports made.

Both national and multinational business firms may have access to the benefits only if they have invested a minimum of 5 percent of their gross billing in research and development. With this, Science and Technology Minister Jose Israel Vargas, anticipates an annual collection of approximately \$300 million.

Any company in the informatics sector may also deduct, at a rate of up to 50 percent of the Income Tax (IR) owed, its spending on research and development in informatics and automation, either direct or indirect. Firms in any branch may deduct up to 1 percent of the IR owed, from 1992 to 1997, provided that they apply an equal sum to an informatics company's stock shares.

**National Firms**

According to Minister Vargas, the reason for the postponement was the fact that the National Congress has not yet voted on the bill governing public bidding competitions, "without which we can't go ahead with Article 3," as he remarked to this newspaper yesterday. That article of the Informatics Law stipulates preference for informatics products and goods manufactured by Brazilian companies with national capital in purchases made by all the organs of the federal public administration, whether direct or indirect.

According to the informatics coordinator of the Ministry of Industry, Commerce, and Tourism, Dorgival Brandoao, there is another reason for the postponement of the regulations: "We simply failed to obtain consensus among the parties on the regulations for that article," he claimed.

**Complete Text of the Bill****Decree No. 792, of 2 April 1993**

Regulating Articles 2, 4, 6, 7, and 11 of Law No. 8,248, of 23 October 1991, based on the conditions specified, and issuing other provisions.

The President of the Republic, using the authority conferred upon him by Article 84, Paragraph IV, of the

Constitution, and taking into account the provisions of Laws Nos. 7,232, of 29 October 1984, and 8,191, of 11 June 1991, and of the Second National Plan for Informatics and Automation (PLANIN), approved by Law No. 8,244, of 16 October 1991,

Decrees:

## Chapter I

### On Tax Incentives

Article 1. Exempted from the Tax on Manufactured Products (IPI), until 29 October 1999, based on the provisions of Article 1 of Law No. 8,191, of 11 June 1991, and Article 4 of Law No. 8,248, of 23 October 1991, are informatics and automation goods with local value added levels compatible with the features of each product, manufactured in the country by business firms meeting the requirements specified in Articles 2 or 11 of the latter legal statute, as well as the respective accessories, spare parts, and tools accompanying those goods in a normal quantity.

Single Paragraph. The maintenance and use of the IPI credit relating to raw materials, intermediate products, and packing materials used in the processing of the goods cited in the heading of this article are assured, as stipulated in Article 1, Section 2, of Law No. 8,191/91.

Article 2. Business firms whose sole or principal purpose is the production of informatics and automation goods and services in the country shall deduct, up to a limit of 50 percent of the Income and Gains Tax of any kind owed, the duly proven amount of spending carried out in the country on research and development activities in informatics and automation, directly, or in a contract with other Brazilian companies, research centers or institutes, or educational establishments, official or recognized, without precluding the deductibility of those outlays as an operational expense.

Single Article. The benefit specified in this article may be accrued from 1 January 1992 until 31 December 1997 by business firms meeting the requirements specified in Article 1 of Law No. 8,248/91; and from 29 October 1992 until 31 December 1997, by business firms not meeting those requirements.

Article 3. Corporations may deduct up to 1 percent of the Income Tax owed, during each accounting period from 1992 to 1997, inclusive, provided that they have applied directly, as of the date of submission of the Annual Declaration, the same amount to new issues of stock shares in stock companies that meet the requirements of Article 1, of Law No. 8,248/91, and have as their sole or main activity the production of informatics and automation goods and services. Applications to firms belonging to the same economic conglomerate as the investor are prohibited.

Section 1. The tax deduction cited in this article is also applicable to subscriptions of new stock shares originating from the practice of establishing a subscription bonus.

Section 2. The subscribed stock shares may not be transferred for a period of two years counted from the subscription date.

Section 3. The stock share issuing firm and the investing corporation shall be considered members of the same economic conglomerate, for purposes of this article, when both have a common controlling stockholder. A controlling stockholder is interpreted as the individual or corporation, or group of persons associated by a voting agreement, that is the holder of stock shares ensuring the absolute majority of capital stock votes.

Section 4. Closed stock companies may obtain funds based on incentives, through private subscription, only when advertising material, services of third parties dissociated from the company, or members of the bearer securities distribution system are not used for this purpose.

Section 5. If the firms mentioned in the preceding paragraph should attempt to obtain funds based on incentives, through public subscription, they must first request of the Securities and Exchange Commission (CVM) registration as a company open for negotiation on the Stock Exchange, or over the counter, and registration for public distribution.

## Chapter II

### On Granting of Incentives

Article 4. To be entitled to accrue the benefits specified in the preceding articles, the firm producing informatics and automation goods and services must request of the Ministry of Science and Technology (MCT):

- I. the granting of the incentive discussed in Article 1 for goods manufactured by it, justifying its fulfillment of the criteria stipulated in Article 6, Section 1;
- II. its qualification to benefit from the incentive mentioned in Article 2, proving that it meets the conditions stipulated in Article 12;
- III. its qualification for obtaining funds resulting from the incentive specified in Article 3, proving its status as a stock company meeting the requirements of Article 1 of Law No. 8,248/91, and that its sole or main activity is the production of informatics and automation goods and services based on the terms specified in Article 12.

Single Paragraph. The requests must be drawn up in accordance with the instructions issued by the MCT.

Article 5. When it has been proven that the conditions cited in paragraphs II and III of the preceding articles have been met, a joint administrative directive of the MCT and the Ministry of Finance (MINIFAZ) shall be

published in the Official Gazette of the Union, certifying the firm's qualification to benefit from the incentive cited in Article 2, or to obtain the funds based on incentives specified in Article 3.

**Article 6.** The list of goods, identifying the product and its manufacturer, that will give entitlement to the benefit specified in Article 1 shall be defined by the Executive Branch, through a joint administrative directive of the MCT and MINIFAZ, at the proposal of the National Council for Informatics and Automation (CONIN).

**Section 1.** To include a product on the list of goods discussed in the heading of this article, the CONIN must consider, either cumulatively or not, besides the local value added, as stipulated in the joint MCT and Ministry of Industry, Commerce and Tourism administrative directive, the following indicators:

- a) quality, considering compliance with national or international standards, or standards applicable to the product and the productive process, the existence of certification of the good by accredited laboratories, and the warranty period offered;
- b) price, without IPI and ICMS [Goods Movement Tax], considering its compatibility with the international price of an imported counterpart, this being defined as the CIF [cost, insurance, freight] price, added to the Import Tax, the customs costs, and those for transportation on the national territory;
- c) international competitiveness, taking into account the export volume of the product and the firm;
- d) the firm's technological capacity, considering the volume of financial, material, and human resources allocated for research and development activities, and the spending on programs for training and developing human resources.

**Section 2.** The fiscal notes relating to the marketing of the goods cited in Article 1 must make express mention of the joint administrative directive discussed in this article.

### Chapter III

#### On the Beneficiary's Obligations

**Article 7.** To be entitled to the benefits stipulated in Articles 1 to 3, business firms whose purpose is the production of informatics and automation goods and services must apply, during every calendar-year, a minimum of 5 percent of their gross billing from the sale of informatics and automation goods and services on the domestic market, with levied taxes deducted, to informatics and automation research and development activities, to be carried out in the country based on a plan devised by the firms themselves.

**Section 1.** A minimum of 2 percent of the gross billing mentioned in the heading of this article must be applied, during every calendar-year, to contracts with Brazilian

research centers or institutes, or Brazilian educational establishments, official or recognized, as defined in Article 13.

**Section 2.** In the event that an application specified in the heading of this article fails to reach the minimum amount set therein, without precluding the provisions of Section 1, the residual value, corrected monetarily and with 12 percent added, must necessarily be applied during the next calendar-year, with the normal application pertaining to that same period observed.

**Article 8.** To be entitled to the benefits specified in Articles 1 and 2, business firms that do not meet the requirements of Article 1 of Law No. 8,248/91 must prepare programs for the effective training of their technical staff in technologies for products and production processes, as well as progressive programs for the export of informatics and automation goods and services, without precluding the provisions of Article 7.

**Section 1.** To implement the export program cited in the heading of this article, the business firm must, during every calendar-year, show a positive commercial balance, interpreted as the difference between the value of exported and imported informatics and automation goods and services, including their parts and components, or show a net export income at least equal to the value of the incentives discussed in Article 1.

**Section 2.** If the business firm should fail to implement the export program as specified in the preceding paragraph, the residual value, corrected monetarily and with 12 percent added, shall be deducted from the result of the commercial balance or the export income pertaining to the subsequent calendar-year, without precluding the provisions of Section 1 of this article.

**Article 9.** The beneficiary firm must, by the date set for the submission of the Annual Declaration, send to the MCT statements supporting its fulfillment of the obligations stipulated in Articles 7 and 8 during the previous year.

**Section 1.** The applications discussed in the heading of Article 7 and its Section 1 must pertain to the billing that occurred from the beginning of the month of the first accrual of the benefit until the close of the corresponding calendar-year, with that same period adopted for the commercial balance cited in Article 8, Section 1.

**Section 2.** The supporting statements shall be assessed by the MCT and MINIFAZ, which shall publish the results of their analysis in the Official Gazette of the Union.

**Section 3.** In addition to the statements specified in the heading of this article, the beneficiary firm must send the following to the MCT during the same period:

- a) statements supporting the billing resulting from the marketing, during the previous year, of goods covered by the incentive in Article 1, and its fulfillment of the conditions stipulated in Article 6, Section 1;

- b) statements of financial-physical execution of the research and development activities conducted during the previous year, supporting its fulfillment of the conditions stipulated in Article 12, to benefit from the incentive cited in Article 2;
- c) statements supporting the funds accrued during the previous year, and its fulfillment of the conditions cited in Article 4, III, to qualify for accruing the funds discussed in Article 3.

Section 4. The statements cited in this article must be prepared in accordance with the instructions issued by the MCT, based on guidance from the CONIN.

#### Chapter IV

##### On Penalties

Article 10. Any business firm that fails to meet the requirements cited in Article 4, or does not fulfill the demands stipulated in Articles 7 to 9, shall lose the right to accrue the benefits, without precluding the indemnification stipulated in Article 9 of Law No. 8,248/91.

#### Chapter V

##### On Monitoring and Evaluation

Article 11. It shall be incumbent on the CONIN, without precluding the authority of other organs of public administration, to engage in monitoring and evaluating the use of the incentives cited in Articles 1 to 3, in implementing the research and development activities cited in Articles 2 and 7, as well as the programs specified in Article 8; and also to oversee fulfillment of the obligations stipulated in this decree.

#### Chapter VI

##### On General Provisions

Article 12. For purposes of this decree, a business firm is considered to have as its sole or main purpose or activity the production of informatics and automation goods and services if it has such a goal or activity as its corporate purpose, and if its gross billing from the marketing of said goods and services produced or rendered by it has been, in the immediately preceding calendar-year, larger than the gross billing from the marketing of other goods and services, in both instances with the levied taxes deducted.

Single Paragraph. For purposes of this article, informatics and automation services are interpreted as:

- a) the programming and analysis of digital information processing systems;
- b) services involving data entry, data processing, and computer resources administration;
- c) services associated with digital information processing systems; information services using data bank, videotext, and electronic message techniques;

planning, research, design, consulting, engineering, including integration engineering, and technical auditing in informatics and automation; training in informatics and automation; and other related services;

- d) marketing of computer programs of its own production.

Article 13. For purposes of this decree, Brazilian research centers or institutes, or Brazilian educational establishments, are interpreted as:

- I. research centers or institutes maintained by organs and entities of public administration, direct or indirect; foundations established and maintained by the public authorities; and other organizations under the direct or indirect control of the Union, the Federal District, States, or Municipalities, which are engaged in informatics and automation research and development activities.
- II. private law research centers or institutes that are engaged in informatics and automation research and development activities, and meet the following requirements:
  - a) they may not distribute any portion of their net worth or income for profit-making, or distribute a share in the results, in any form, to their principals;
  - b) they must apply their funds for the maintenance of their institutional objectives totally in the country;
  - c) they must assign their net worth, in the event of dissolution, to a similar entity meeting the requirements stipulated herein.
- III. Brazilian educational establishments recognized by the Ministry of Education and Sports, which comply with the provisions of Article 213, I and II, of the Federal Constitution, or are maintained by the public authorities as defined in Paragraph I.

Article 14. For purposes of this decree, research and development activities are considered to be:

- I. Research: theoretical or experimental work done systematically to acquire new knowledge, aimed at attaining a specific objective, discovering new applications, or acquiring a full, precise understanding of the foundations underlying the phenomena and events observed, without prior definition of the practical utilization of the results of that work;
- II. Development: systematic work using the knowledge acquired in the research or in practical experience, to develop new materials, products, or mechanisms; to implement new processes, systems, or services; or to improve those already produced or established, by incorporating innovative features;

- III. Training in science and technology: specialized training on the intermediate or advanced level; as well as improvement and post-graduate work on the advanced level;
- IV. Scientific and technical service; services involving advising or consulting, prospective studies, tests for standardization, metrology, or quality; as well as those provided by information and documentation centers;
- V. Quality system; training and certification programs aimed at the establishment of management programs and those for quality guarantees.

Section 1. To be included as spending on research and development are the outlays made for the performance or contracting of the activities specified in the heading of this article, relating to:

- a) acquisition or use of computer programs, machines, equipment, apparatus, and instruments, and their accessories, spare parts, and tools, as well as installations;
- b) civil construction works;
- c) direct and indirect human resources;
- d) acquisition of books and periodicals;
- e) consumer materials;
- f) travel;
- g) training;
- h) services of third parties;
- i) participation, including that in the form of contributions of financial resources, in the execution of programs and projects of national concern considered a priority by the MCT;
- j) payments made in the form of "royalties," scientific and technical assistance, and specialized and similar services, for the transfer of technology developed as stipulated in the heading of this article, by Brazilian research centers or institutes, or educational establishments complying with the provisions of the preceding article.

Section 2. The amount of the application discussed in Article 7, Section 1, relates to the relative portion of the payment of expenses and salaries in educational or research institutions made by the business firm, excluding other expenses of its own, or those contracted with other business firms, incurred on the basis of an agreement.

Section 3. For purposes of this decree, the donation of informatics and automation goods and services is not considered a research and development activity.

Section 4. The spending devoted to the purchase or use of goods and services supplied by one or more participating business firms, necessary for conducting the research and development activities discussed in this article, may be computed, in accounting for the amount spent, based on the cost amounts or, otherwise, on the sums representing 50 percent of the sale or leasing prices, or those for transfer of a right to use relative to the period of its use, in effect at the time for the end user.

Article 15. For the purposes specified in this decree, informatics and automation goods and services are considered those associated with the rational, automatic processing of information, based on the terms of Article 3 of Law No. 7,232, of 29 October 1984.

Article 16. To account for the monetary values relating to this decree, the daily Reference Fiscal Unit (Ufir) shall be used, making the conversion based on the latter's value on the last day of the month to which the event corresponds.

Article 17. The MCT and MINIFAZ may issue complementary instructions for the execution of this decree.

Article 18. The MCT, after hearing the Ministries entrusted with the matter, may, with "ad-referendum" [referral for further approval] to the CONIN, make the necessary decisions regarding the implementation of this decree.

Article 19. This decree goes into effect on the date of its publication.

Article 20. Decree No. 574, of 23 June 1982, is revoked.

Brasilia, 2 April 1993; 172nd year of independence, and 105th year of the Republic.

Itamar Franco Eliseu Resende Jose Eduardo de Andrade Vieira Jose Israel Vargas

#### Commentary on Law

93WS0443C Sao Paulo GAZETA MERCANTIL  
in Portuguese 6 Apr 93 p 14

[Report by Heloisa Magalhaes from Rio]

[Text] The decree containing regulations for the Informatics Law, published yesterday in the Official Gazette of the Union, brings to the forefront the controversy over a possible return to protection of the national industry in that sector, and the possibility of a new type of market reserve being recreated. This is so because only equipment using boards assembled in the country will be entitled to exemption from the IPI [Tax on Manufactured Products]. Imported products will again pay the IPI, which they have not done since last November. Theoretically, this will make them 15 percent more expensive, as business owners from the sector told this newspaper yesterday.

Unlike the times of the market reserve, when permission to sell was given exclusively to Brazilian firms with national

capital, the stimulus for production of boards in the country benefits both national and international firms. (For example, IBM will continue to sell boards made in Campinas, even for the PS/2 microcomputers.) And the argument used by the Ministry of Science and Technology (MCT) for this type of requirement is based on the interpretation that any incentive should be granted to stimulate local industrialization, and should not make the price of the imported product more attractive.

The lack of a distinction between the national and imported item for IPI exemption was stipulated in Law No. 8,191, signed in 1991 during the Collor government, dealing with capital goods in general. And, with the termination of the market reserve, it ended up benefiting informatics equipment. From November to March of this year, five months elapsed in which the consumer became used to seeing direct competition between Brazilian and foreign brands on the shelf. On the industrial side, at the beginning of the Collor government signals started to be given that there would be total openness on the market, with a lack of incentive for local industrialization. This process led to massive layoffs of research and development staffs from business firms. Between 1989 and 1991, the shrinkage of investments and in the sector's development amounted to 67 percent, declining from \$226 million to \$65 million, according to an MCT survey.

With the change in government, the negotiations on regulations for the Informatics Law and a stimulus for local industrialization were resumed. The basic principle of the incentives was to be "local value added": the same criteria established for the Manaus Free Trade Zone "productive process." In both instances, the incentives are linked to local assembly of boards and mechanical parts. The government's strategy was to devise one and the same industrial policy for the North and the rest of the country, changing only the type of incentives.

Representing Automatica, the association of informatics industries, businessman Pietro Biselli, president of the Sisinter holding company, a national group operating in the industrial automation and printers segment (the Rima brand), maintains that there should be no price increase for the national products. He reports that there are more than 30 Brazilian board suppliers engaged in the process of installing chips on printed circuit boards, manufacturing the part that becomes the "soul" of the computer. The unbridled international competition in this segment, with Asian "tigers" offering increasingly lower prices, does not frighten the businessman. He thinks that the course of action should be an effort "to reduce Brazilian prices with a tariff policy and incentives, with a tax waiver that would protect the local assemblers."

Antonio Augusto Souza, from the Ministry of Science and Technology's informatics and automation policy

secretariat, reports that zero tariffs have begun to be negotiated for board components, and that the goal is to return Brazilian production to the international market. Differentiated treatment is planned in the requirements to be placed on local assembly: sophisticated, small-scale boards, like those for large-sized computers, for example, will have liberated importing.

As Ernesto Camelo, from the Text and Image firm in Rio selling Apple and Compaq equipment, remarks, the change in rules will bring an immediate impact on resellers. Since countless established brands have no local industrialization, there will be a price hike, and a resultant resumption of the presence of contraband on the market which, he claims, has been losing margins of competitiveness since the liberalization of imports. And he adds: "Once again, the one who will pay the bill is the consumer."

## TELECOMMUNICATIONS

### Brazil: Fiber Optic Network Planned for Coastal Cities

93WS0463A *Sao Paulo GAZETA MERCANTIL*  
in Portuguese 16 Apr 93 p 3

[Text] By 1996, the Brazilian Telecommunications Company (Embratel) will invest \$703 million in the establishment of a fiber optic cable network linking Fortaleza with Porto Alegre. It will pass through all of the country's capitals located along the coast.

This announcement was made yesterday in Rio by the company's president, Renato Archer, during the signing of a contract with the Federal Railway Network (RFFSA).

According to the Brasil Agency, the contract signed between RFFSA and Embratel is intended to establish the fiber optic system along the railroad, in the section between Ponta Grossa, Curitiba, and Paranagua. Involving funds totaling \$50 million, it stipulates that the Railway Network must carry out the civil construction work, whereas Embratel will be responsible for installing the 36-fiber optic cable.

Archer claimed that the Brazilian fiber optic system will also cover Brasilia, Sao Paulo, Belo Horizonte, and Goiania, besides the capitals along the coast. It will have a link, on the one hand, with the Unisul cable, which will interconnect the Mercosul [Common Market of the South] countries; and, on the other, with the "America 1" fiber optic submarine cable, which will link Fortaleza with Florida, in the United States.

The contract was also signed by the president of the Railway Network, Osiris Guimaraes, and by the network's directors for development and investment.

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